CYCLES OF THE PYRAMIDS

Technical Guide to a Hydro-Powered Radio Observatory

By

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Contents

Dedicated to GRANDMOTHERS and GRANDDAUGHTERS.

Chapter 1

GENERAL

1.1 INTRODUCTION

This technical guide details an observatory complex powered by the energy of falling water.

The complex includes TRANSMITTER and RECEIVER pyramids in addition to related devices and underground service tunnels, all interconnected to serve various functions.

This guide focuses specifically on the ability of the observatory to make celestial measurements accurately and repeatedly, scaling our solar system to a resolution provided by radio astronomy.

1.2 LISTS

1.2.1 FIGURES

List of Figures

1.2.2 SYMBOLS

Table 1.1: Summary of Symbols, SYMBOLS

Symbol	Description	Unit	Page list
a	Largest linear dimension of either the transmitting or receiving antenna	m	28
A_e	Effective aperture area of the antenna	m^2	28
A_{em}	Maximum effective aperture area of the antenna	m^2	28
A_{moon}	Physical cross section (projected area) of the Moon	m^2	138
A_{venus}	Physical cross section (projected area) of Venus	m^2	137
$A_{mercury}$	Physical cross section (projected area) of Mercury	m^2	139

1.2.3 CONSTANTS

The table presents a summary of definitions used in the text.

These definitions include mathematical and physical constants.

An appendix lists technical variables in metric and in the units of the Builders.

Table 1.2: Summary of Constants, CONSTANTS

Symbol	Value	Units	Page	Definition
π	3.14159...	n/a	const	ratio circle circumference to diameter
ϕ	1.618...	n/a	const	golden ratio
e	2.7183...	n/a	const	base of natural logarithm
ϵ_0	8.854×10^{-12}	F/m	const	permittivity of free space
μ_0	$4\pi \times 10^{-7}$	N/A^2	const	permeability of free space
R	8.314	$\frac{cm^3 MPa}{K^{-1}mol^{-1}}$	const	gas constant
G	6.022×10^{-28}	$\frac{kgm^2}{sec^2}$	const	gravitational constant

Continued on next page

Table 1.2 – continued from previous page

Symbol	Value	Units	Page	Definition
ρ_{H_2O}	1000	kg/m^3	const	density of water (liquid)
$\rho_{granite}$	2700	kg/m^3	const	density of granite
$B_{granite}$	50×10^9	Pa	const	bulk modulus of granite
$\rho_{limestone}$	2250	kg/m^3	const	density of limestone
$B_{limestone}$	65×10^9	Pa	const	bulk modulus of limestone
$A.U.$	149.6×10^9	m	const	Astronomical Unit
R_{Earth}	6371	km	??	Earth radius

Continued on next page

Table 1.2 – continued from previous page

Symbol	Value	Units	Page	Definition
R_{Venus}	6052	km	**??**	Venus radius
g	9.80	m/s^2	const	acceleration of gravity
K	43200	n/a	31	scale factor (object)
c	299,792,458	m/s	const	speed of light / scale factor (system)
R_{EARTH}	Radius of Earth (polar)	6356 km	31	

Part I

TRANSMITTER

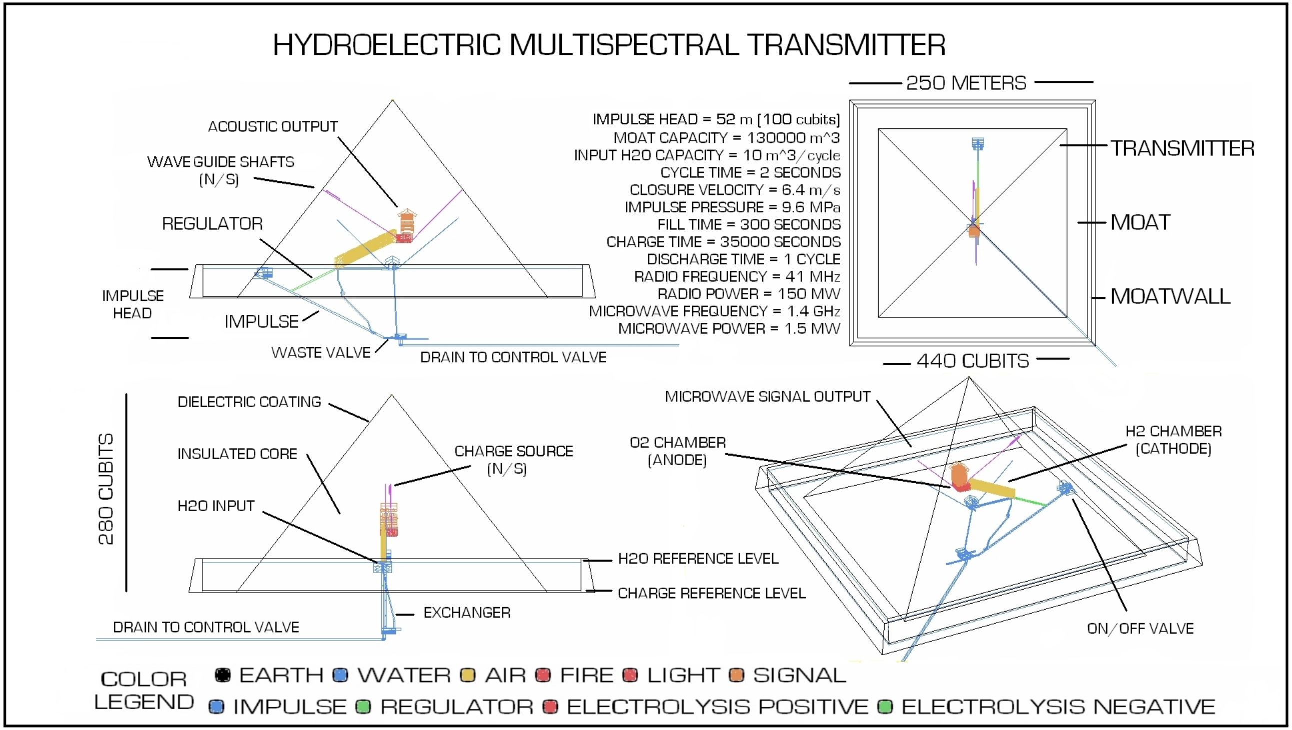


Figure 1.1: TRANSMITTER SYSTEMS DIAGRAM

Chapter 2

GENERAL

The TRANSMITTER is an internal combustion radio frequency generator that uses the kinetic energy of a moving column of water and the electric field of the Earth to produce and transmit a microwave signal.

2.1 OPERATION

The TRANSMITTER is powered by the IMPULSE system (water hammer) driving the REGULATOR system (ram pump) into the COMBUSTION (electrolysis) system.

Every cycle water accelerates down the IMPULSE SHAFT past the open WASTE VALVE at the end.

As the water accelerates at a certain velocity the WASTE VALVE closes, quickly stopping the rushing water.

Water will not be compressed so its momentum translates into a pressure surge that travels back up the IMPULSE SHAFT towards the MOAT.

The pressure surge of the IMPULSE briefly drives water through the REGULATOR towards the RESONANCE CHAM-

BER and other chambers above.

After filling those chambers the water is pressurized and subsequently heats up as steam.

Electric currents from the GUIDE SHAFTS activate electrolysis to produce oxygen and hydrogen gas.

The vertical internal design operates on these gases by density.

Under controlled periodic conditions these gases are ignited and combust, generating an acoustic energy release that stimulates a piezoelectric response at radio frequencies.

The RF energy is tapped by a cavity resonator to produce repeatable microwave pulses, the SIGNAL.

2.2 SYSTEMS

Summary of TRANSMITTER systems functionally sorted by classical element.

2.2.1 EARTH

This section describes materials found in the TRANSMITTER as a physical object itself, dry and inert.

2.2.2 WATER

This section describes the hydro-power systems, IMPULSE and REGULATOR.

2.2.3 AIR

This section describes the electrolysis and gas production systems involving the COMBUSTION CHAMBER and the RESONANCE CHAMBER.

Relevant electrically charged systems appear here also.

2.2.4 FIRE

This section describes the IGNITION and COMBUSTION system.

2.2.5 LIGHT

This section describes the ACOUSTIC and RADIO systems.

Relevant SIGNAL and ANTENNA systems appear here also.

Chapter 3

EARTH

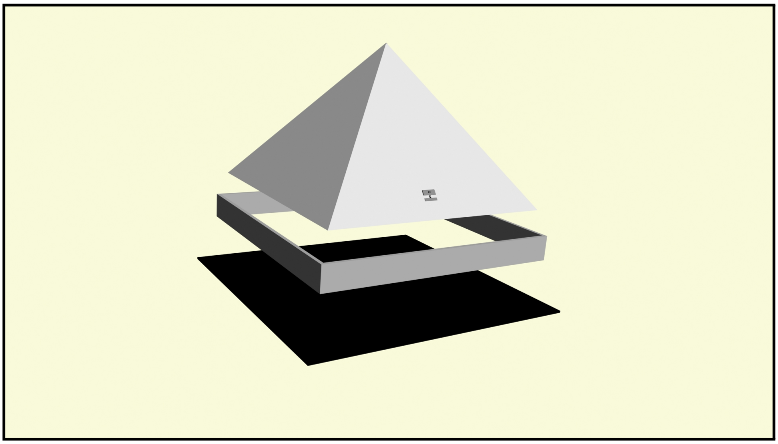


Figure 3.1: MAIN EARTH

3.1 GENERAL

The TRANSMITTER is made of materials, most carved from natural shape in addition to manufactured materials such as metals and geopolymers.

The structure can be considered composed of substructures:

the PYRAMID, the BASE, and the MOAT.

The BASE is the interface between the dressed bedrock and the PYRAMID underside.

The MOAT is a wall that surrounds the PYRAMID and contains water used to power the TRANSMITTER.

These equations present material estimates used in the structure.

3.2 PYRAMID

This section concerns the PYRAMID substructure of the TRANSMITTER.

3.2.1 DIMENSIONS

The dimensions of the TRANSMITTER are based on the dimensions of the Earth.

See also ORRERY.

HEIGHT

The height of the TRANSMITTER is given as 146.7m.

The height of the TRANSMITTER represents the polar radius of Earth divided by a proportionality constant K. Where

$$R_{EARTH} = 6.356 \times 10^6 m \tag{3.1}$$

and

$$K = 43200 \tag{3.2}$$

$$H_{xmtr} = \frac{R_{earth}}{K} \tag{3.3}$$

$$H_{xmtr} = \frac{6.356 \times 10^6}{43200} \tag{3.4}$$

$$H_{xmtr} = 147m \tag{3.5}$$

PERIMETER

Each side of the TRANSMITTER is 230.3m. The perimeter of the TRANSMITTER is given as 921.2m.

The perimeter of the TRANSMITTER represents the spherical circumference of a great circle with polar radius divided by the proportionality constant K. Where

$$P_{xmtr} = \frac{2\pi R_{earth}}{K} \tag{3.6}$$

$$P_{xmtr} = \frac{2\pi(6.356 \times 10^6 m)}{43200} \tag{3.7}$$

$$P_{xmtr} = 921m \tag{3.8}$$

SIDE

Each side of the PYRAMID is one fourth its perimeter.

$$B_{xmtr} = 230.3m \tag{3.9}$$

3.2.2 LIMESTONE

Most of the TRANSMITTER is made of limestone, from onsite sources or nearby.

DIMENSIONS

These equations present estimates of limestone volume used in the PYRAMID substructure.

Internal chambers are considered negligible for these estimates.

$$\rho_{core} = 1760 - 2560 kg/m^3 (core) \tag{3.10}$$

Value for this analysis for core density is $2250 kg/m^3$.

$$\rho_{casing} = 2650 - 2850 kg/m^3 (casing) \tag{3.11}$$

Value for this analysis for casing density is $2750 kg/m^3$.

BEDROCK

Part of the native limestone bedrock was not leveled underneath the PYRAMID substructure.

This equation presents an estimate of the natural bedrock limestone incorporated into the PYRAMID substructure.

$$Volume = 0.25 \times 10^6 m^3 \tag{3.12}$$

CAST

Part of the PYRAMID structure was made of cast limestone geopolymer.

Estimates include upper part of substructure and outer casing.

$$Volume = 1.00 \times 10^6 m^3 \tag{3.13}$$

CUT

Part of the PYRAMID structure was made of cut limestone.

Estimates include inner core.

CALCULATIONS Quantities calculated from estimated dimensions.

$$Volume = 0.75 \times 10^6 m^3 \tag{3.14}$$

TOTAL

$$TotalVolume(limestone) = Total_{bedrock} + Total_{cut} + Total_{cast} \tag{3.15}$$

$$TotalVolume(limestone) = 2.00 \times 10^6 m^3 \tag{3.16}$$

3.2.3 GRANITE

Part of the PYRAMID internal structure was made of cut granite.

DIMENSIONS

$$\rho_{granite} = 2700 kg/m^3 \tag{3.17}$$

$$Volume(granite) = 580 \times 10^3 m^3 \tag{3.18}$$

$$Volume(granite) = 0.58 \times 10^6 m^3 \tag{3.19}$$

$$M_{granite} = 1.57 \times 10^6 kg \tag{3.20}$$

3.2.4 METAL

Estimates of metal used in the TRANSMITTER.

GOLD

$$\rho_{Au} = 19320 kg/m^3 \tag{3.21}$$

$$V_{Au} = 1000 m^3 \tag{3.22}$$

$$M_{Au} = 19.3 \times 10^6 kg \tag{3.23}$$

IRON

$$\rho_{Fe} = 7874 kg/m^3 \tag{3.24}$$

$$V_{Fe} = 1 m^3 \tag{3.25}$$

$$M_{Fe} = 7874 kg \tag{3.26}$$

COPPER

$$\rho_{Cu} = 8920 kg/m^3 \tag{3.27}$$

$$V_{Cu} = 0.1 m^3 \tag{3.28}$$

$$M_{Cu} = 892 kg \tag{3.29}$$

3.3 BASE

This section concerns the BASE substructure of the TRANSMITTER. The BASE is made largely of black basalt.

3.3.1 DIMENSIONS

The BASE acts as an interface between the structure above and the bedrock below.

LENGTH

BASE is assumed a square 280m on a side.

$$L_{BASE} = 280 m \tag{3.30}$$

THICKNESS

Average thickness of BASE.

$$T_{BASE} = 2 m \tag{3.31}$$

3.3.2 CALCULATIONS

Quantities calculated from estimated dimensions.

VOLUME

BASE volume is a rectangular solid.

$$V_{BASE} = L_{BASE}^2 \times H_{BASE} \tag{3.32}$$

$$V_{BASE} = 280 m^2 \times 2 m \tag{3.33}$$

$$V_{BASE} = 156.8 \times 10^3 m^3 \tag{3.34}$$

$$\rho_{basalt} = 2800 kg/m^3 \tag{3.35}$$

MASS

$$M_{BASE} = (\rho_{basalt})(V_{BASE}) \tag{3.36}$$

$$M_{BASE} = (\rho_{basalt})(156.8 \times 10^3 m^3) \tag{3.37}$$

3.4 MOAT

This section concerns the MOAT substructure of the TRANSMITTER.

3.4.1 LIMESTONE

The MOAT could be made entirely of limestone.

These equations present estimates of volume of limestone used in the MOAT substructure.

DIMENSIONS

MOAT dimensions are estimated minimums to withstand internal water pressure.

LENGTH Assumed a perfect square, its width and length are identical.

$$L_{MOAT} = 247m \tag{3.38}$$

THICKNESS Average thickness of MOAT (estimate, minimum).

$$T_{MOAT} = 2m \tag{3.39}$$

HEIGHT Height of MOAT (estimate, minimum).

$$H_{MOAT} = 25m \tag{3.40}$$

VOLUME The volume of the MOAT wall can be calculated as a rectangular solid after subtracting an inner core.

$$V_{MOAT_{OUTER}} = L_{MOAT}^2 \times H_{MOAT} \tag{3.41}$$

$$V_{MOAT_{INNER}} = (L_{MOAT} - T_{MOAT})^2 \times H_{MOAT} \tag{3.42}$$

Subtract inner solid volume from outer solid volume:

$$V_{MOAT} = L_{MOAT}^2 \times H_{MOAT} - (L_{MOAT} - T_{MOAT})^2 \times H_{MOAT} \tag{3.43}$$

$$V_{MOAT} = (L_{MOAT}^2 - (L_{MOAT} - T_{MOAT})^2) \times H_{MOAT} \tag{3.44}$$

$$V_{MOAT} = (2 \times L_{MOAT} - T_{MOAT}^2) \times H_{MOAT} \tag{3.45}$$

$$V_{MOAT} = (2 \times 247 - 2^2) \times 25 \tag{3.46}$$

$$V_{MOAT} = 12250 m^3 \tag{3.47}$$

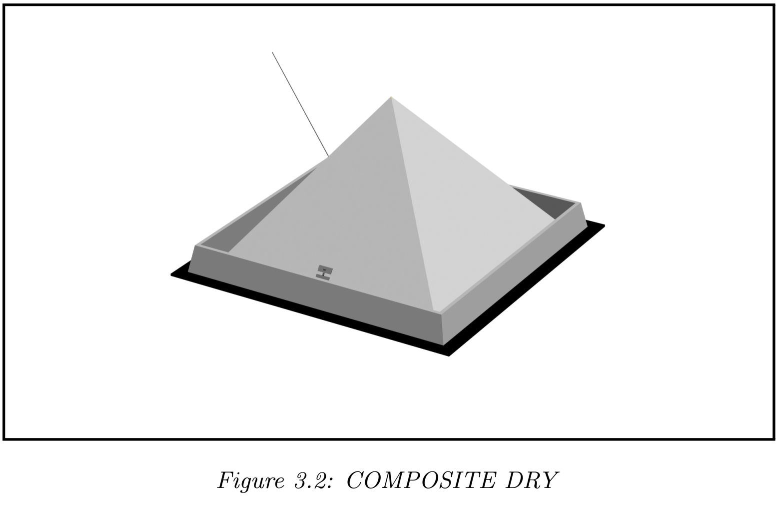


Figure 3.2: COMPOSITE DRY

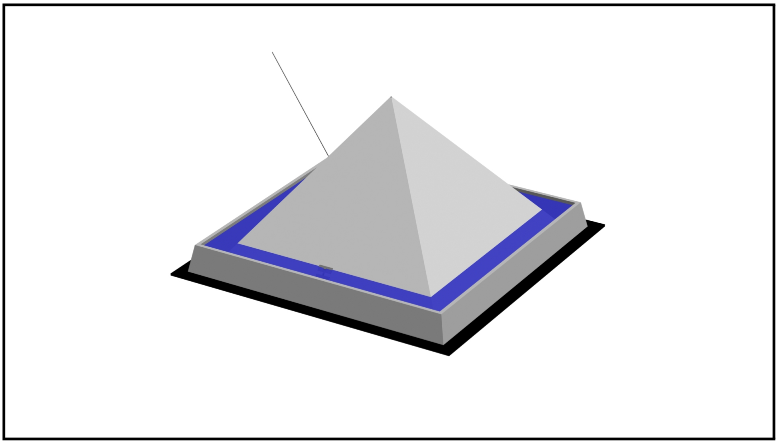


Figure 3.3: COMPOSITE WET

3.5 SUMMARY

3.5.1 VOLUME

Volume total is PYRAMID volume plus MOAT volume.

PYRAMID volume is one-third height dimension times base dimension.

$$V_{PYRAMID} = \frac{1}{3}(147m)(230m)^2 \tag{3.48}$$

$$V_{PYRAMID} = 2.59 \times 10^6 m^3 \tag{3.49}$$

Of this volume the core is estimated at 95% and the casing at 5%.

Note the volume of the pyramid is several orders larger than that of the moat.

$$V_{total} = V_{PYRAMID} + V_{MOAT} \tag{3.50}$$

$$V_{total} = 2.59 \times 10^6 m^3 + 12.25 \times 10^3 m^3 \tag{3.51}$$

$$V_{total} = 2.60 \times 10^6 m^3 \tag{3.52}$$

3.5.2 MASS

The mass of the pyramid involves the density of the different limestones used in construction.

$$M_{PYRAMID} = V_{PYRAMID} \times (0.95 \times \rho_{core} + 0.05 \times \rho_{casing}) \tag{3.53}$$

$$M_{PYRAMID} =$$

$$(2.59 \times 10^6 m^3)((0.95)(2250 kg/m^3) + (0.05)(2750 kg/m^3)) \tag{3.54}$$

$$M_{total} = 5.9 \times 10^9 kg \tag{3.55}$$

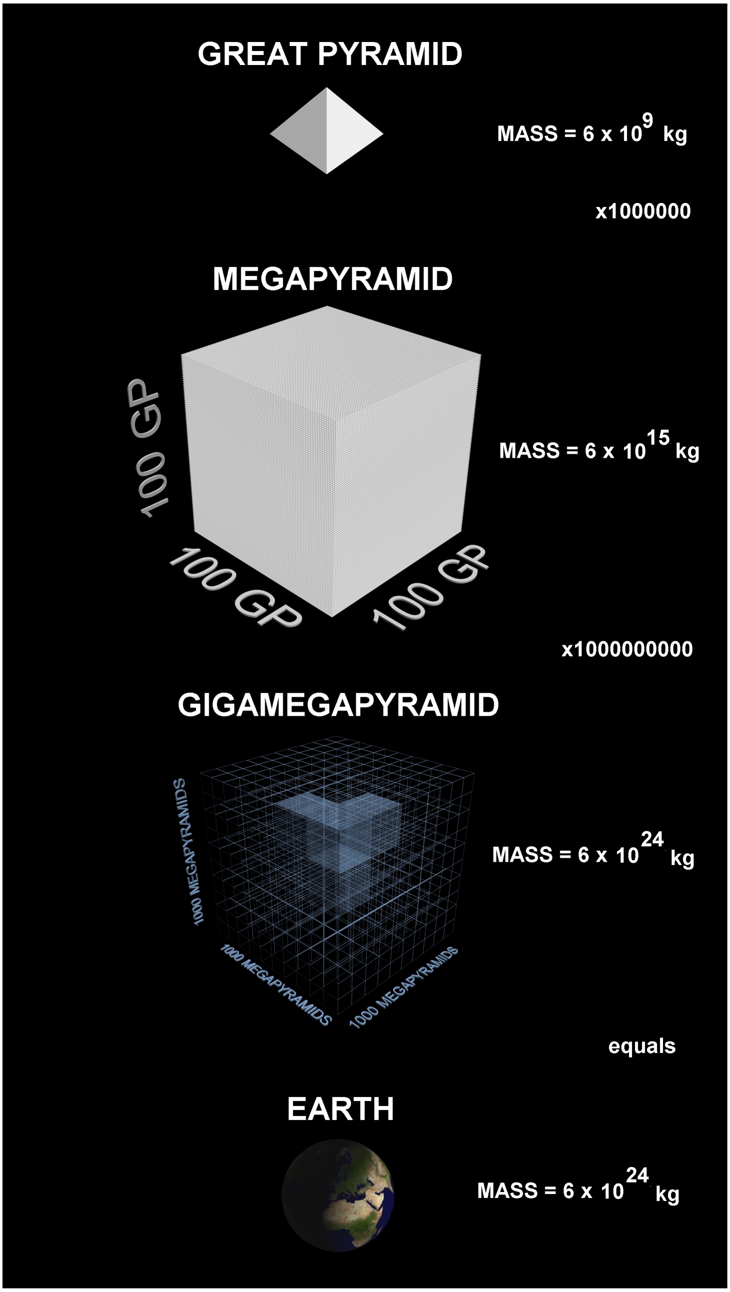


Figure 3.4: EARTH MASS AS GIGAMEGAPYRAMID

3.5.3 ENERGY

Calculate the potential energy stored in the mass of the structure.

Where the differentiable mass is defined as square slices of dm

$$dm = \rho x^2 dy \tag{3.56}$$

given the slope of the pyramid

$$y = H(1 - x/B) \tag{3.57}$$

rearrange for x

$$x = B(1 - y/H) \tag{3.58}$$

substitute in (3.56)

$$dm = \rho B^2 (1 - \frac{2y}{H} + \frac{y^2}{H^2}) dy \tag{3.59}$$

the differentiable potential energy along the vertical axis y from the ground to the top of the pyramid H is the height of the slice times g

$$dU_{PYRAMID} = g \int_0^H y \rho B^2 (1 - \frac{2y}{H} + \frac{y^2}{H^2}) dy \tag{3.60}$$

rearrange

$$dU_{PYRAMID} = g \rho B^2 \int_0^H (y - \frac{2y^2}{H} + \frac{y^3}{H^2}) dy \tag{3.61}$$

solve

$$U_{PYRAMID} = \frac{g \rho B^2 H^2}{12} \tag{3.62}$$

throw in values

$$U_{PYRAMID} = \frac{(9.80m/s^2)(2250kg/m^3)(230m)^2(147)^2}{12} \tag{3.63}$$

$$U_{PYRAMID} = 2.098 \times 10^{12} J \tag{3.64}$$

3.5.4 WORK

An average human for an 8 hour work shift can maintain 75W.

per man-year

$$W = 75\frac{J}{s}(\pi \times 10^7 s) \tag{3.65}$$

per worker then

$$W = 75\pi \times 10^7 J/yr \tag{3.66}$$

Calculate man-years required to elevate pyramid mass.

$$MY_{min} = \frac{2.098 \times 10^{12} J}{75\pi \times 10^7 J/yr} \tag{3.67}$$

$MY_{min} = 890$ man-years

Assuming one eight-hour shift per day means only 1/3 of each year is usable. Assuming two eight-hour shifts per day means only 2/3 of each year is usable. Consequentially the impact of man-year schedule should be tripled or doubled accordingly.

This calculation is for elevating stones only, not cutting, preparing, providing any horizontal motion, or final placement.

Chapter 4

WATER

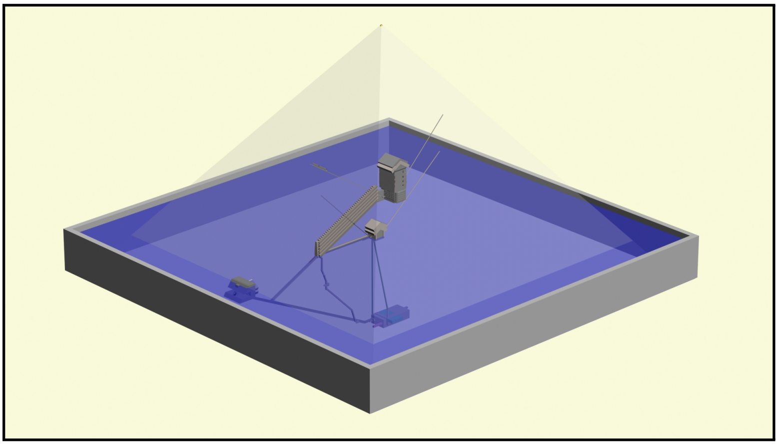


Figure 4.1: MAIN WATER

Several systems of the TRANSMITTER depend on water in either liquid or gas form.

4.1 GENERAL

TRANSMITTER water related systems include the MOAT (fresh water source) to source a gravitationally elevated supply of water, the IMPULSE (water hammer) to generate

timed pulses of high pressure, and a REGULATOR (ram pump) to inject pressurized pulses into the COMBUSTION CHAMBER.

4.2 MOAT

The MOAT as a water source supplies all needs of the TRANSMITTER.

4.2.1 FEED

Water pressure head is maintained by oversupply from higher source and spill-over directed to lower drain through a causeway.

4.2.2 CAPACITY

MOAT capacity is that volume of water contained inside the MOAT wall and outer casing of PYRAMID substructure.

CROSS SECTION

The cross-section containing water inside the MOAT can be considered a right triangle between the MOAT and the PYRAMID casing.

One side of this right triangle is the height of the ON/OFF VALVE - the opening for water - at 20 m.

$$L = 20m \tag{4.1}$$

One side of this right triangle is the distance between MOAT and PYRAMID at the ON/OFF VALVE.

$$P = 18m \tag{4.2}$$

This cross-section has an area $\frac{1}{2}$LP

$$A = 180m^2 \tag{4.3}$$

and extends around the PYRAMID perimeter.

Ignoring overlap at corners, the MOAT capacity can be estimated by

$$C_{moat} = A * P \tag{4.4}$$

$$C_{moat} = (180m^2)(921m) \tag{4.5}$$

$$C_{moat} = 166 \times 10^3 m^3 \tag{4.6}$$

Volume is amount of water actually kept in MOAT, must be less than capacity.

$$V_{MOAT} = 130 \times 10^3 m^3 \tag{4.7}$$

Height of water inside MOAT must be no lower than the level of the ON/OFF VALVE or the IMPULSE will halt.

4.2.3 MASS

The supply is effectively fresh water with a density ρ_{H_2O}

$$\rho_{H_2O} = 1000kg/m^3 \tag{4.8}$$

Mass of this water is therefore V_{MOAT} (4.7) times this density.

$$M_{MOAT} = V_{MOAT} \times \rho_{H_2O} = 130 \times 10^6 kg \tag{4.9}$$

4.2.4 HEAD

The head represents the vertical distance between the top of the MOAT and the bottom of the SUBCHAMBER outlet to DRAIN.

Gravitational energy available in the water depends on this value.

$$H_{IMPULSE} = 52.36m \tag{4.10}$$

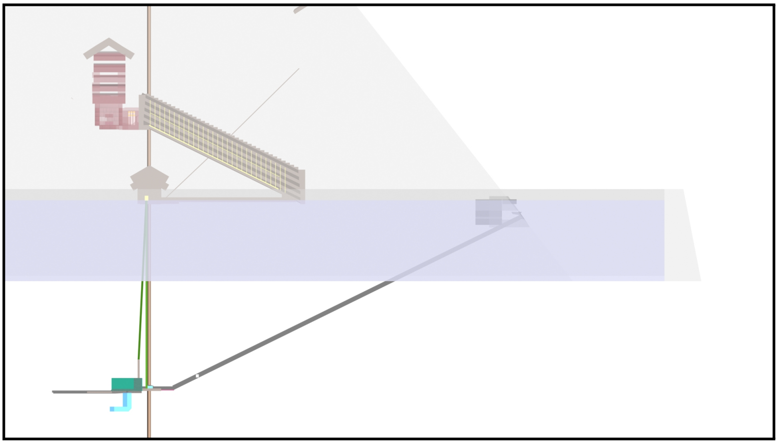


Figure 4.2: FEED HEAD

4.3 IMPULSE

The water for the IMPULSE is supplied by the MOAT.

All output of the water IMPULSE system is through either the VALVE (drained) or the REGULATOR (pumped).

These equations characterize the IMPULSE SHAFT, modeled as a squared tunnel along a 2:1 angle (see Figure 1.1).

4.3.1 HEIGHT

The height of the IMPULSE SHAFT, used to calculate cross-sectional area.

$$H_{SHAFT} = 2\frac{2}{7}cubits = 16palms = 1.1968m \tag{4.11}$$

4.3.2 WIDTH

The width of the IMPULSE SHAFT, used to calculate cross-sectional area.

$$W_{SHAFT} = 2cubits = 14palms = 1.0472m \tag{4.12}$$

4.3.3 AREA

Calculated cross-sectional area of SHAFT.

$$A_{SHAFT} = H_{SHAFT} \times W_{SHAFT} = 1.2533m^2 \quad (4.13)$$

4.3.4 LENGTH

The length of the IMPULSE SHAFT, used to calculate volume.

This value is for the mathematical purpose of the model and may approximate but not accurately represent any physical length in the structure.

$$L_{SHAFT} = 105m \quad (4.14)$$

4.3.5 VOLUME

Calculated volume of the IMPULSE SHAFT.

$$V_{SHAFT} = A_{SHAFT} \times L_{SHAFT} \quad (4.15)$$

$$V_{SHAFT} = (1.25m^2) \times (105m) \quad (4.16)$$

$$V_{SHAFT} = 131.25m^3 \quad (4.17)$$

Note: IMPULSE volume (4.17) is much smaller compared to MOAT volume (4.7).

4.3.6 RIPPLE

Ripple is estimated on order of 10cm.

4.3.7 ANGLE

This is the arctangent of a 2:1 right triangle.

$$\theta_{SHAFT} = \tan^{-1}(0.5) = 26.5^\circ \quad (4.18)$$

4.3.8 MASS

Mass of water inside IMPULSE SHAFT is density times volume.

$$M_{SHAFT} = \rho_{H_2O} \times V_{SHAFT} \tag{4.19}$$

$$M_{SHAFT} = (1000kg/m^3)(131.25m^3) \tag{4.20}$$

$$M_{SHAFT} = 131250kg \tag{4.21}$$

4.3.9 ENERGY

Issues about energy. Thermodynamic considerations still required.

POTENTIAL

Potential Energy available in volume of water at IMPULSE head.

$$PE_{IMPULSE} = mgh \tag{4.22}$$

$$PE_{IMPULSE} = M_{SHAFT} \times g \times H_{IMPULSE} \tag{4.23}$$

$$PE_{IMPULSE} = (131250kg)(9.80m/s^2)(52.36m) \tag{4.24}$$

$$PE_{IMPULSE} = 67.35 \times 10^6 J \tag{4.25}$$

KINETIC

Maximum possible velocity limited to theoretical value where all source potential energy converts to kinetic energy.

$$KE_{IMPULSE} = PE_{IMPULSE} \tag{4.26}$$

VELOCITY

This value will be used to calculate steady state flow, that is, flow with waste VALVE removed.

$$KE_{IMPULSE} = \frac{1}{2}MV^2 \tag{4.27}$$

$$\frac{1}{2}MV^2 = PE_{IMPULSE} \tag{4.28}$$

$$V^2 = \frac{(2)(PE_{IMPULSE)}}{M} \tag{4.29}$$

$$V^2 = \frac{(2)(67.35 \times 10^6 J)}{131250kg} \tag{4.30}$$

$$V^2 = 1026m^2/s^2 \tag{4.31}$$

$$V_{max} = 32.0m/s \tag{4.32}$$

This theoretical value for velocity represents an outer bound and does not account for friction or other inefficiencies.

4.3.10 CYCLE TIME

Basic cycle time is 2 seconds.

$$T_{cycle} = 2s \tag{4.33}$$

4.3.11 POWER

Power is Energy per unit time.

$$P_{IMPULSE} = \frac{PE_{IMPULSE}}{T_{cycle}} \tag{4.34}$$

$$P_{IMPULSE} = \frac{67.35 \times 10^6 J}{2s} \tag{4.35}$$

$$P_{IMPULSE} = 33.68 \times 10^6 W \tag{4.36}$$

This value represents a theoretical maximum only.

4.3.12 VALVE

The IMPULSE VALVE is a hinged stone that rotates into a cavity in the SHAFT outside the north entrance to the SUB-CHAMBER.

The recessed position is the OPEN position of the VALVE, allowing water flow (see Fig. **??**).

As water accelerates past the VALVE it eventually reaches closure velocity V_c and pressure behind the VALVE extends it into the flow.

The fully extended position is the CLOSED position of the VALVE, blocking water flow (see Fig. **??**).

The sudden change in momentum compels water in the SHAFT to convert kinetic energy of flow to potential energy of pressure.

This pressure wave returns along the IMPULSE SHAFT at high speed to the MOAT.

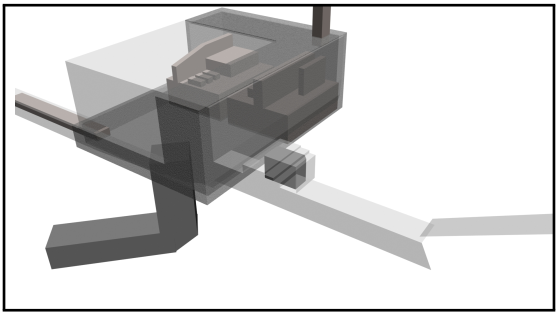


Figure 4.3: VALVE OPEN

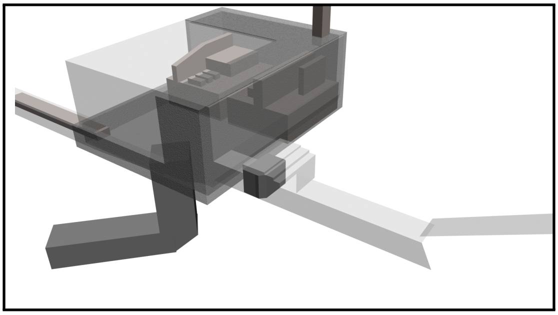


Figure 4.4: VALVE CLOSED

VOLUME

The volume of the VALVE is approximately two cubic meters

$$V_{VALVE} \approx= 2.0m^3 \tag{4.37}$$

MASS

The mass of the VALVE is density of material times volume:

$$M_{VALVE} = \rho_{limestone} \times V_{VALVE} \tag{4.38}$$

$$M_{VALVE} \approx= 5 \times 10^3 kg \tag{4.39}$$

CLOSURE TIME

The VALVE closes in

$$T_{close} = 0.02s \tag{4.40}$$

CLOSED

In the CLOSED position no water may flow past the IMPULSE VALVE.

Closure of the VALVE results in impact of the VALVE face against the eastern wall.

This also emits an acoustic pulse.

4.3.13 SUBCHAMBER

The OPEN state of the VALVE allows free flow of water down the IMPULSE SHAFT and towards the SUBCHAMBER and DRAIN.

The SUBCHAMBER also acts as a pressure source against the VALVE re-opening it every cycle.

VOLUME

The SUBCHAMBER is irregularly shaped to direct water currents so volume is estimated about 8.3x4x14 = 465 m^3

EXCHANGE

The SUBCHAMBER has a gas and particulate EXCHANGE with the REFERENCE CHAMBER.

GAS

The SUBCHAMBER releases trapped gas via a poppet release located on the ceiling near the west wall.

4.3.14 DRAIN

The DRAIN removes water from the TRANSMITTER.

EXIT

The DRAIN empties near the Sphinx.

LENGTH

The DRAIN is estimated to be 600 m long.

VOLUME

The DRAIN is estimated to have a cross-section of 1.25 m. This yields a volume of

$$V = 1.25m^2x600m$$

$$V = 750m^3.$$

CONTROL

Control of DRAIN velocity and SUBCHAMBER pressure would be possible at this point as would device charge potential.

By adjusting the SUBCHAMBER pressure and DRAIN velocity, the acceleration of water through the IMPULSE SHAFT is directly adjusted.

By adjusting water acceleration the maximum pressure of the IMPULSE is directly adjusted.

4.3.15 FLOW

Input water flow through IMPULSE SHAFT, maximum theoretical value.

$$F_{IMPULSE} = V_{IMPULSE}/T_{cycle} = 131m^3/2s \tag{4.41}$$

$$F_{IMPULSE} = 65.6m^3/s \tag{4.42}$$

$$Q_{IMPULSE} = M_{SHAFT}/T_{cycle} = 131250kg/2s \tag{4.43}$$

$$Q_{IMPULSE} = 65.6 \times 10^3 kg/s \tag{4.44}$$

FRICTIONLESS

Steady state flow equation for velocity with VALVE open and no friction where S represents that component of gravitational acceleration parallel with the flow. This is the sine of the angle of the shaft (4.18).

$$S = \sin(\theta_{SHAFT}) = sin(26.5) \tag{4.45}$$

Thus flow acceleration is given by

$$a = \frac{dv}{dt} = gS \tag{4.46}$$

Integrate:

$$v = \frac{dl}{dt} = (gS)t \tag{4.47}$$

Starting from rest (v=0 at t=0) the time required to achieve $v = 4.32$ is

$$t = \frac{v}{gS} = \frac{32.0m/sec}{(sin(26.5))(9.8m/s^2)} \tag{4.48}$$

$$t = 7.32sec \tag{4.49}$$

Integrate again:

$$l = \frac{(gS)}{2}t^2 \tag{4.50}$$

Length of IMPULSE SHAFT (4.14)

$$105 = \frac{(9.8)sin(26.5)}{2}t^2 \tag{4.51}$$

$$t^2 = 48.0sec^2 \tag{4.52}$$

$$t = 6.93sec \tag{4.53}$$

FRICTION

Steady state flow equation for velocity with VALVE open and including friction:

$$a = \frac{dv}{dt} = gS(1 - k^2v^2) \tag{4.54}$$

The factor k^2 represents loss due to SHAFT friction. This acceleration terminates and velocity settles to a constant when

$$k = \frac{1}{v_\infty} \tag{4.55}$$

Equation 4.54 can be solved as follows. Rearrange as

$$\frac{dv}{(1-k^2v^2)} = gSdt \tag{4.56}$$

Substitute $u = kv$, $u^2 = k^2v^2$, and $du = kdv$ for

$$\frac{du}{k(1-u^2)} = gSdt \tag{4.57}$$

$$\frac{du}{(1-u^2)} = gkSdt = \frac{gS}{v_\infty}dt \tag{4.58}$$

Integrate and replace v

$$\tanh^{-1}(kv) = \frac{gS}{v_\infty}t \tag{4.59}$$

$$\frac{v}{v_\infty} = tanh(\frac{gS}{v_\infty}t) \tag{4.60}$$

The fraction relating velocities to the maximum velocity attainable is the normalized velocity λ.

$$\lambda = \frac{v}{v_\infty} = \frac{e^{2\tau}-1}{e^{2\tau}+1} \tag{4.61}$$

Where

$$\tau = \frac{gSt}{v_\infty} \tag{4.62}$$

CLOSURE

Closure velocity is the water speed where the VALVE begins to close.

This velocity is a design choice and may be effected by back pressure from the SUBCHAMBER.

Where $\lambda = 0.23$ of terminal velocity:

$$V_{closure} = 0.23 \times 32m/s \tag{4.63}$$

$$V_{closure} = 7.4m/s \tag{4.64}$$

SIMULATION

Computer simulations show above this point the IMPULSE pressure wave drives the REGULATOR to velocities that surpass any reverse motion during the unpressured part of each cycle.

INCREMENT

Every cycle the water column in the IMPULSE SHAFT advances by the second integral of the acceleration equation.

For the case without friction acceleration is constant

$$\frac{dv}{dt} = a = gS \tag{4.65}$$

so

$$v = gSt \tag{4.66}$$

and the INCREMENT is given by

$$x = \int \frac{dv}{dt} = \frac{1}{2}gSt^2 \tag{4.67}$$

For a cycle time of 2 seconds:

$$x = \frac{1}{2}(9.8\frac{m}{s^2})(sin(26.5°)(2s)^2 \tag{4.68}$$

$$x = 8.75m \tag{4.69}$$

For the case with friction assume x=v=0 at t=0. Using notation from the velocity derivation (4.60

$$x = \int \frac{dv}{dt} = v_\infty \int_0^{T_c} tanh(\frac{gS}{v_\infty}t)dt \tag{4.70}$$

Integrate from 0 to closure time T_c

$$x = \frac{v_\infty^2}{gS} ln(cosh(\frac{gS}{v_\infty}T_c)) \tag{4.71}$$

For $T_c = 1.7sec$ the cycle increment is

$$x = \frac{(32m/sec)^2}{(9.8m/sec)(sin(26.5))} ln(cosh(\frac{9.8m/sec^2 sin(26.5)}{32m/sec}(1.7sec))) \tag{4.72}$$

$$x_{INC} = 6.3m \tag{4.73}$$

INPUT VOLUME

The input volume of water per cycle can be calculated as equal to the INCREMENT length times the area of the IMPULSE SHAFT.

$$V_{INC} = 6.3m \times 1.25m^2 = 7.83m^3 \tag{4.74}$$

Note this is per 2 second cycle.

4.3.16 PULSE

By the Joukowsky equation for fluids, the magnitude of a pressure pulse change equals density of fluid times speed of sound in fluid times magnitude of velocity change.

$$\Delta P_p = \rho c \Delta V \tag{4.75}$$

Speed of sound in a fluid:

$$c = \sqrt{\frac{K^*}{\rho}} \tag{4.76}$$

$$K^* = K \frac{1}{1 + \frac{DK}{\rho E}} \tag{4.77}$$

Calculate pressure spike for water velocity at closure velocity (4.64):

$$\Delta P_p = (1000kg/m^3)(1500m/sec)(7.4m/sec) \tag{4.78}$$

$$\Delta P_p = 11 \times 10^6 \frac{kg}{msec^2} = 11MPa \tag{4.79}$$

In terms of atmospheres:

$$\Delta P_p = 110ATM \tag{4.80}$$

$$\Delta P_p = 11 \times 10^6 \frac{N}{m^2} \tag{4.81}$$

$$\Delta P_p = 11 \frac{N}{mm^2} \tag{4.82}$$

This is the maximum pressure the IMPULSE system can provide to the upper chambers.

It is attentuated by the REGULATOR system.

4.3.17 SPEED

The pressure pulse travels through the IMPULSE SHAFT at the speed of sound in water contained in a SHAFT, given by this equation:

$$a = \sqrt{\frac{\left(\frac{(K)}{(\rho)}\right)}{\left(1 + \frac{(K)(D)}{(e)(E)}\right)}} \tag{4.83}$$

PIPE

To calculate the speed of sound for water the IMPULSE SHAFT is modeled as a pipe with rigid but elastic walls.

The SHAFT contains the water inside limestone so those values will be used.

$$K_{H_2O} = 2.2 \times 10^9 Pa = 2.2 GPa \tag{4.84}$$

$$E_{limestone} = 15 - 55 GPa \tag{4.85}$$

$$K_{limestone} = 65 GPa \tag{4.86}$$

FOR $e = \infty$

$$a^2 = \frac{K}{\rho} \tag{4.87}$$

$$a = 1485 m/sec \tag{4.88}$$

FOR $e = 1$ m

$$a^2 = \frac{\left(\frac{\left(2.2 \times 10^9 Pa\right)}{\left(997 \frac{kg}{m^3}\right)}\right)}{\left(1 + \frac{(2.2 \times 10^9 Pa)(1.26m)}{(1m)(15 \times 10^9 Pa)}\right)} \tag{4.89}$$

$$a = 1365 m/sec \tag{4.90}$$

FOR $e = 10$ m

$$a = 1472 m/sec \tag{4.91}$$

These values are approximately

$$a = 1500m/sec = 1.5\frac{m}{msec} \tag{4.92}$$

and this value will be used for analysis.

4.3.18 CYCLE

Each cycle starts immediately upon closure of the VALVE.

Each cycle sends the pressure pulse up and back the length of the IMPULSE SHAFT, twice.

This is four equal runs, enumerated:

(1) During the first run, the pressure wave travels away from the VALVE up to the MOAT.

At the last quarter of its travel the pressure wave impacts the REGULATOR.

(2) During the second run, the pressure wave reflects off the MOAT and returns towards the VALVE.

After the first quarter of its travel the pressure wave no longer impacts the REGULATOR.

(3) During the third run, the pressure returns to normal in another pulse that travels up towards the MOAT.

At the VALVE concurrent conditions of low pressure and low velocity allow SUBCHAMBER pressure to push the VALVE back into its OPEN position over this and the following leg.

(4) During the fourth run, the wave reflects from the MOAT and water in the IMPULSE SHAFT starts to accelerate past the open VALVE.

Acceleration continues until closure velocity is reached and the VALVE closes, beginning another cycle.

TRAVEL

This four-leg path represents a total travel length:

$$D_{pulse} = 4L = 4 * (105m) \tag{4.93}$$

$$D_{pulse} = 420m \tag{4.94}$$

TIMING

Calculate the reflection time of the SHAFT:

$$T_{pulse} = \frac{D_{pulse}}{a} \tag{4.95}$$

$$T_{pulse} = \frac{420m}{1.5 \times 10^3 m/s} \tag{4.96}$$

$$T_{pulse} = 0.28s = 280msec \tag{4.97}$$

ACCELERATION TIME

By (4.61) with $lambda = 0.23$

$$\lambda = 0.23 = \frac{7.4}{32} = \frac{e^{2\tau} - 1}{e^{2\tau} + 1} \tag{4.98}$$

rearrange and solve for τ

$$0.23(e^{2\tau} + 1) = e^{2\tau} - 1 \tag{4.99}$$

$$0.23e^{2\tau} + 0.23 = e^{2\tau} - 1 \tag{4.100}$$

$$0.77e^{2\tau} = 1.23 \tag{4.101}$$

$$e^{2\tau} = \frac{1.23}{0.77} \tag{4.102}$$

$$2\tau = ln(\frac{1.23}{0.77}) \tag{4.103}$$

$$\tau = 1/2 \times ln(\frac{1.23}{0.77}) \tag{4.104}$$

$$\tau = 0.2342 \tag{4.105}$$

The time for the IMPULSE flow to reach the closure velocity is from (4.62)

$$0.2342 = gS/V_\infty t = \frac{(9.8m/sec^2)(sin(26.5))t}{32m/s} \tag{4.106}$$

$$T_{IMPULSE} = 1.7s \tag{4.107}$$

TOTAL TIME

Calculate total cycle time:

$$T_{cycle} = T_{closetime} + T_{pulsetimecycle} + T_{acceltime} \tag{4.108}$$

$$T_{cycle} = 0.02s + 0.28s + 1.7s \tag{4.109}$$

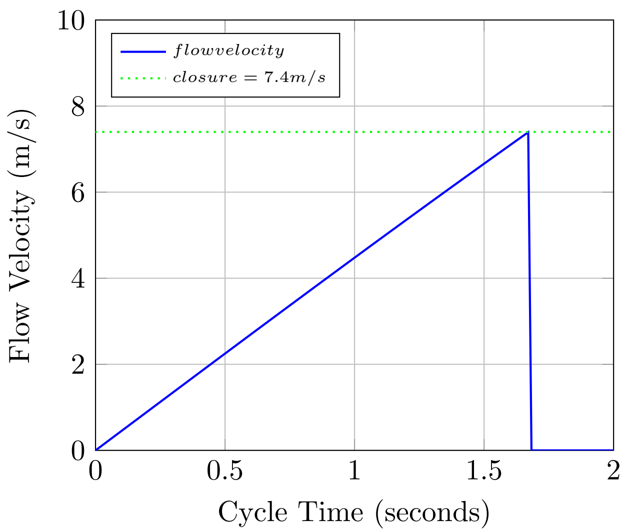


Figure 4.5: IMPULSE FLOW VELOCITY CLOSURE 7.4m/s CYCLE 2.0s 30BPM

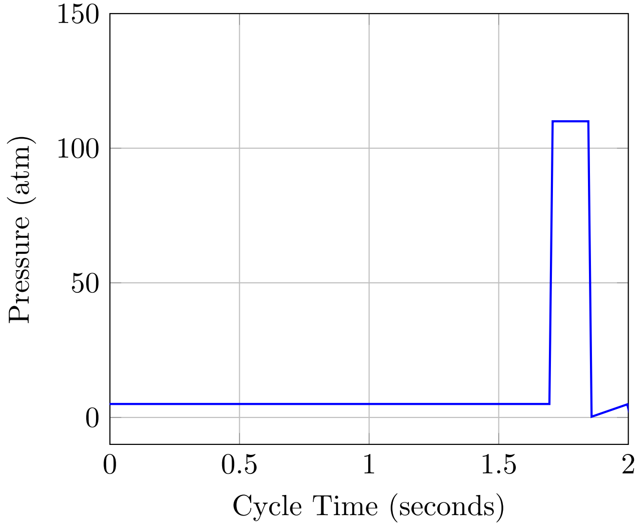


Figure 4.6: IMPULSE VALVE PRESSURE CLOSURE 7.4m/s CYCLE 2.0s 30BPM

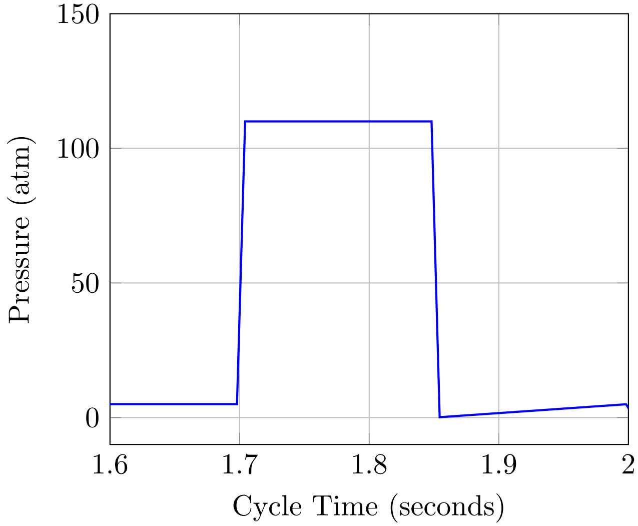


Figure 4.7: IMPULSE VALVE PRESSURE CLOSURE 7.4m/s CYCLE 2.0s 30BPM

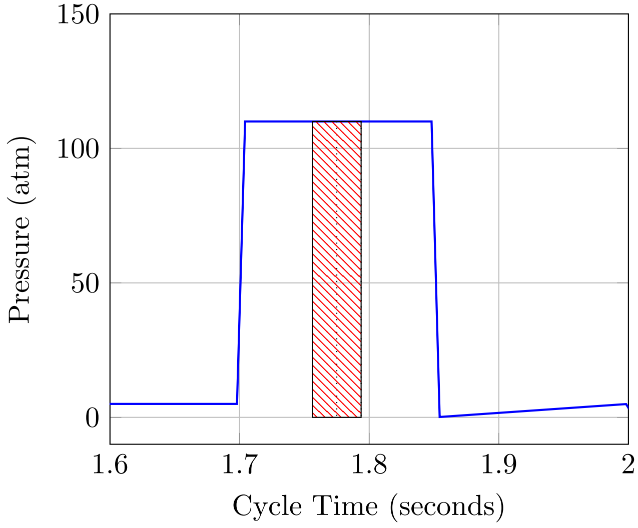


Figure 4.8: REGULATOR ACTIVE TIMING CLOSURE 7.4m/s CYCLE 2.0s 30BPM

4.4 REGULATOR

The REGULATOR system connects the IMPULSE system to the COMBUSTION system.

4.4.1 PULSE

The pressure pulse developed by the IMPULSE is sufficient to open the REGULATOR VALVE.

This supplies pulses of high pressure water to the upper chambers of the TRANSMITTER, pressurizing them in the process.

$$V_{pulsed} = 8.6m^3 \tag{4.110}$$

4.4.2 SENSOR

As the charged PLUGS passes the stationary SENSOR they induce electromagnetic currents.

Cross-section shows the SENSOR located near the level of the ON/OFF VALVE.

4.4.3 PLUGS

The REGULATOR PLUG consists of three granite stones that are free to move (along the long dimension) in the REGULATOR SHAFT.

The PLUG exposes a surface area to the IMPULSE SHAFT equal to:

$$A_{REGULATOR} = 1.25m^2 \tag{4.111}$$

VOLUME

Each stone is approximately 2 m in length with a cross-section approximately 1.25 m^2

$$V_{stone} = L * A \tag{4.112}$$

$$V_{stone} = (2m)(1.25m^2) \tag{4.113}$$

$$V_{stone} = 2.5m^3 \tag{4.114}$$

MASS

Each stones masses the density of granite times this volume:

$$M_{stone} = \rho_{granite} * V_{stone} \tag{4.115}$$

$$M_{stone} = (2700kg/m^3)(2.5m^3) \tag{4.116}$$

$$M_{stone} = 6750kg \tag{4.117}$$

Three stones together mass:

$$M_{REGULATOR} = 3 \times M_{stone} \tag{4.118}$$

$$M_{REGULATOR} = (3)(6750kg) \tag{4.119}$$

$$M_{REGULATOR} = 20250kg \tag{4.120}$$

This is approximately 20×10^3 kg and that value will be used for analysis.

4.4.4 ACCELERATION

The REGULATOR PLUGS are accelerated according to the force applied to the exposed face times the area of the PLUG.

$$F_{PLUG} = P \times A \tag{4.121}$$

$$F_{PLUG} = (9.6 \times 10^6 \frac{N}{m^2})(1.25m^2) \tag{4.122}$$

$$F_{PLUG} = 12e6N \tag{4.123}$$

To calculate PLUG acceleration, at first ignore the water above the stones.

Force equals product of mass and acceleration, acceleration is force divided by mass.

$$A_{PLUG} = 12e6N/20 \times 10^3 kg \tag{4.124}$$

$$A_{PLUG} = 600m/s^2(max) \tag{4.125}$$

Then with no more than L/4-5.25 of water mass at 1.25 m2

$$V_{H_2O} = \frac{L}{4} - 5.25 \times A \tag{4.126}$$

$$V_{H_2O} = (\frac{105}{4} - 5.25)(1.25m^2) \tag{4.127}$$

$$V_{H_2O} = 26.25m^3 \tag{4.128}$$

Mass of this water is density times volume

$$M_{H_2O} = \rho_{H_2O} \times V_{H_2O} \tag{4.129}$$

$$M_{H_2O} = (1000kg/m^3)(26.25m^3) \tag{4.130}$$

$$M_{H_2O} = 26250kg \tag{4.131}$$

$$A_{PLUG} = 12e6N/(26.25 + 20) \times 10^3)kg \tag{4.132}$$

$$A_{PLUG} = 259.5m/s^2(max) \tag{4.133}$$

This acceleration is roughly between 25 and 60 g's for a percent of each cycle.

4.4.5 DUTYCYCLE

The REGULATOR system begins $L_{IMPULSE}/4 = 27m$ along the length of the IMPULSE PIPE.

This is approximately one-quarter the length of the IMPULSE.

$$f_d = 27m \tag{4.134}$$

IMPULSE pressure is only present at the REGULATOR input for 1/8 cycle

L+L + L+L

4L = 8L/2

8x(L/2)=(8L/2)

$$dc_{IMPULSE} = 1/8 = 0.125 \tag{4.135}$$

Since the entire pulse time is 280 msec, 1/8 of this would be 35 msec.]

$$dc_{IMPULSE} = 1/8(280msec) = 35msec \tag{4.136}$$

4.4.6 DISPLACEMENT

The REGULATOR stones are moved under assumed constant acceleration for (4.136) of each cycle.

Assuming no initial velocity ($V_0 = 0$) the standard equation for displacement is second integral of acceleration.

$$x = \frac{1}{2}at^2 \tag{4.137}$$

$$x = \frac{1}{2}(260m/s^2)(.35s)^2 \tag{4.138}$$

$$x \ = 8.6m \tag{4.139}$$

4.4.7 CAPACITY

The capacity of the upper chambers is roughly divided into seven equal sections, a unit volume used for convenience in calculating.

This unit volume is 10 cubits on a side.

REFERENCE CHAMBER volume is approximately one of these units.

$$(10rc)^3 = 1000rc^3 = 1000(pi/6)^3m \tag{4.140}$$

$$V_N = 143.6m^3 \tag{4.141}$$

RESONANCE CHAMBER volume is approximately two of these capacity units and the COMBUSTION CHAMBER approximately four.

The total capacity of the upper chambers is

$$V_{total} = (4+2+1) \times (10rc)^3 = 7000rc^3 = 7 * 1000(pi/6)^3 m \quad (4.142)$$

$$V_{total} = 1004.83m^3 \quad (4.143)$$

The length of the REGULATOR channel is estimated

$$L_{REGULATOR} = 40m \quad (4.144)$$

This value times the area give a maximum volume pulsed through the REGULATOR every cycle.

$$A_{REGULATOR} = 1.25m^2 \quad (4.145)$$

$$V_{REGULATOR} = L_{REGULATOR} \times A_{REGULATOR} \quad (4.146)$$

$$V_{REGULATOR} = (40m)(1.25m^2) \quad (4.147)$$

$$V_{REGULATOR} = 50m^3 \quad (4.148)$$

4.4.8 FILL

To calculate the cycles required for the REGULATOR to deliver enough water to fill the upper chambers, divide the total volume to be filled by the volume of water delivered every cycle.

CYCLES

$$N_{fill} = V_{total}/V_{pulsed} \quad (4.149)$$

$$N_{fill} = \frac{(7)(144m^3)}{8.6m^3/cycle} \quad (4.150)$$

$$N_{fill} = V_{total}/V_{pulsed} = 117cycles \quad (4.151)$$

TIME

$$T_{fill} = N_{fill} * T_{cycle} = 117cycles * 2sec/cycle \tag{4.152}$$

$$T_{fill} = 234s \tag{4.153}$$

This rate is throttled back as pressure builds in the COMBUSTION CHAMBER.

As the TRANSMITTER is completely filled with liquid water most internal gases are driven out through the GUIDE SHAFTS N/S.

4.4.9 MODES

The REGULATOR PLUG is considered a monolithic mass for first order analysis.

During each cycle, the behavior of the REGULATOR mass distinguishes modes of operation.

MODE 1

$$P_{upper} << P_{lower} \tag{4.154}$$

With upper pressure much less than lower pressure, the REGULATOR is free to move accelerated by lower pressure and gravity only.

Above a certain pressure (6 MPa by computer simulation) the PLUG climbs without returning to its rest position.

MODE 1A Cyclic PLUG behavior beginning with PLUG trapped against upper end of REGULATOR channel by IMPULSE pressure.

At falling edge of IMPULSE pressure the PLUG falls under gravity.

At the rising edge of the next pulse under acceleration the

PLUG reverses velocity and returns to the top of the channel.

PLUG mass falls a certain distance for the unpulsed part of the cycle.

The unpulsed part of the cycle equals the acceleration Time plus the closure Time.

That sum is on the order of 1.7 second.

Acceleration is due to gravity times the sine of the angle of the REGULATOR CHANNEL.

$$x = \frac{1}{2}(-9.8m/s^2)(sin(26.5))(1.75s)^2 \tag{4.155}$$

$$x = -6.7m \tag{4.156}$$

$$V_0 = -(9.8m/s^2)sin(26.5)(1.75s) = -7.65m/s \tag{4.157}$$

The water injected into the COMBUSTION CHAMBER during this interval is

$$V = AL = (1.25m^2)(6.7m) = 8.4m^3 \tag{4.158}$$

The mass of this water is the density times the volume:

$$M = \rho_{H_2O} \times V \tag{4.159}$$

$$M = (8.4m^3)(1000kg/m^3) \tag{4.160}$$

$$M = 8400kg \tag{4.161}$$

With the force on the REGULATOR as (4.123) plus the mass of the PLUG, acceleration is

$$A = F/M = 12e6N/28400kg = 420m/s^2 \ = 40G's \tag{4.162}$$

The water is accelerated with a final velocity

$$V = at + V_0 = 420m/s^2(.25s) - 7.65 = 97m/s \tag{4.163}$$

Kinetic energy of this water is

$$KE = \frac{1}{2}mV^2 = \frac{1}{2}(8400kg)(105m/s)^2 \tag{4.164}$$

$$KE \ = 40MJ \tag{4.165}$$

MODE 2

$$P_{upper} < P_{lower} \tag{4.166}$$

The PLUG moves upwards as average lower pressure exceeds upper.

PLUG motion is accelerated upwards by lower pressure, decelerated by upper pressure and gravity.

PLUG is sustained dynamically between top and bottom of CHANNEL.

MODE 3

$$P_{upper} > P_{lower} \tag{4.167}$$

The PLUG is in motion downwards as average upper pressure exceeds lower.

PLUG motion is accelerated downwards by upper pressure and gravity, decelerated by lower pressure.

PLUG is sustained dynamically between top and bottom of CHANNEL.

MODE 4

$$P_{upper} >> P_{lower} \tag{4.168}$$

If the upper pressure is much greater than IMPULSE pressure, the REGULATOR remains at the lower end of the REGULATOR CHANNEL.

IMPULSE pressure cannot dislodge it.

This is upper stage overpressure and can damage the device.

4.4.10 CYCLE WORK

Each cycle does work heating the water in the upper chambers after they are full.

To the first order this work equals the kinetic energy of the REGULATOR discharge every cycle (4.165).

$$WORK_{cycle} = 40MJ \tag{4.169}$$

4.4.11 CYCLE POWER

Each cycle does work heating the water in the upper chambers after they are full.

The work does not change the volume of water or its kinetic energy, therefore this work emerges as heat.

$$P_{cycle} = 40MJ/2s = 20MW \tag{4.170}$$

4.4.12 BOIL ENERGY

Assuming input water temperature at 25 deg^C to boil at 100 deg^C at one W per degree C.

$$E_{boil} = 75^{\circ C} \times \frac{4.184J}{1g^{\circ C}} \times (1 \times 10^9 g) \tag{4.171}$$

$$E_{boil} = 314 \times 10^9 J \tag{4.172}$$

4.4.13 BOIL TIME

$$T_{boil} = \frac{314 \times 10^9 J}{40 \times 10^6 J/cycle} \tag{4.173}$$

$$T_{boil} = 7845cycles \approx= 16 \times 10^3 sec = 4.4hours \tag{4.174}$$

4.4.14 EXPANSION

After reaching boiling temperature the water then requires additional heat of evaporation energy.

4.4.15 EVAPORATION

Assuming input water temperature at 100 deg^C to evaporate at 2257 J/g

$$E_{evaptot} = 2257J/g \times (1 \times 10^9 g) \tag{4.175}$$

$$E_{evaptot} = 2257GJ \tag{4.176}$$

As steam is generated it expands.

Under constant volume conditions less liquid water mass is required to fill the upper chambers.

Density of steam at 1 bar pressure and 100 $^{\circ C}$temperature is about 0.6 kg/m^3

$$\rho_{steam} = 0.6\frac{kg}{m^3} \tag{4.177}$$

EVAPORATIONENERGY

Reduction of the mass, hence the energy, required to evaporate is proportional to the ratio of the density of liquid water to the density of steam.

$$E_{evap} = \frac{\rho_{steam}}{\rho_{H_2O}} \times E_{evaptot} \tag{4.178}$$

$$E_{evap} = (\frac{0.6}{1000})(2257GJ) \tag{4.179}$$

$$E_{evap} = 1.35GJ \tag{4.180}$$

EVAPORATIONTIME

$$T_{evap} = \frac{1.35GJ}{40MJ/cycle} \tag{4.181}$$

$$T_{evap} = 34cycles \approx= 1min \tag{4.182}$$

4.5 FOUNTAIN

Fountain effect of water expelled from waveguide channels.

Fountains run off to Sphinx reservoir, run off to TRANSMITTER MOAT, run off to rivers, run off to ground.

4.5.1 FLOW

Mass flow is equal to the REGULATOR mass input per cycle divided by the GUIDE output area.

$$Q_{fountain} = \frac{1}{2}\frac{REGULATORflow}{GUIDEarea} \tag{4.183}$$

$$Q_{fountain} = \frac{1}{2}\frac{20 \times 10^3 kg/2s}{(21cm)^2} \tag{4.184}$$

$$Q_{fountain} = 113kg/s \tag{4.185}$$

$$Q_{fountain} = 113L/s(\approx 1700GPM) \tag{4.186}$$

4.6 EFFICIENCY

Estimated NILE flow $2500 - 3500m^3/s$

Estimated XMTR flow $60m^3/s$

$$I_{xmtr} = 60/3000 = 0.02 \tag{4.187}$$

Estimated REGULATOR flow $10m^3/s$

Estimated INPUT flow $60m^3/s$

$$E_{xmtr} = 10/60 = 0.17 \tag{4.188}$$

Chapter 5

AIR

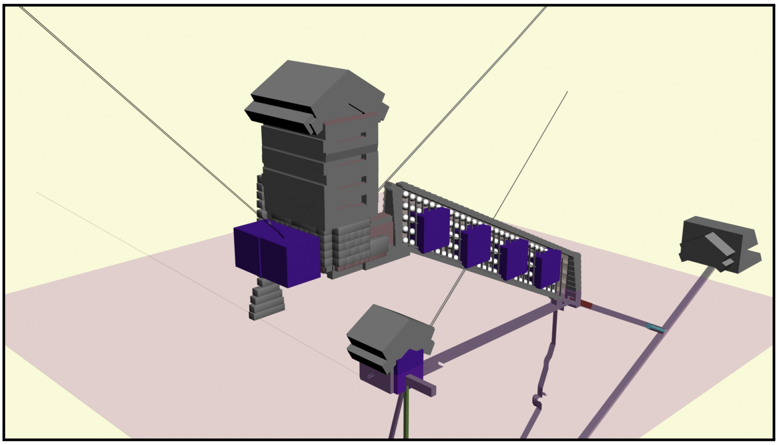


Figure 5.1: MAIN AIR

The TRANSMITTER operates on several gases including hydrogen, oxygen, and steam.

5.1 GENERAL

Energy accumulates in the COMBUSTION CHAMBER until temperature and pressure do not permit liquid water except for the low northern end.

5.2 SEPARATION

At the upper end of the REGULATOR CHANNEL - that is, output of the REGULATOR - is the SEPARATION LINE.

This level is approximately at the same water level as the MOAT.

During operation, after the boiling phase has been reached, below the line is liquid water, above the line is gaseous water (steam) and electrolysized gases.

It represents "ground" or "reference potential" for water and charged systems.

In FIGURE 14.25 the SEPARATION LINE is shown as a colored plane.

5.3 GUIDES

The TRANSMITTER has one GUIDE opening from its south face and another GUIDE opening from its north face.

Each GUIDE is a channel conducive to gas, liquid, and charge.

Each GUIDE has a square cross section 21 cm across.

The north GUIDE is approximately 100 m long and runs at an angle of 40°.

The south GUIDE is approximately 75 m long and runs at an angle of 45°.

Both GUIDES emerge at an altitude of 105 m (200 cubits).

The north GUIDE emerges 10 m west of the south GUIDE.

5.4 VOLUMES

Normalized unit of volume V_N, defined as a 10 cubit cube:

$$V_N = (10cubits)^3 = 1000(cubit)^3 \tag{5.1}$$

$$V_N = 1000(cubit)^3 = 144m^3 = 144000L \tag{5.2}$$

During gas production, hydrogen is limited to the COMBUSTION CHAMBER volume:

$$V_{CC} = V_{H_2} = 4 \times V_N \tag{5.3}$$

During gas production, oxygen is limited to the RESONANCE CHAMBER volume:

$$V_{RC} = V_{O_2} = 2 \times V_N \tag{5.4}$$

5.5 MIXTURE

An enumeration of gases that will at some time be inside the TRANSMITTER including inert gases that do not substantially react. Due to purging during operation the proportion of inert gases is expected to decline after startup.

5.5.1 VOLUMETRIC

Gas mixture in upper chambers. $\mathrm{V}_{total} = \mathrm{V}_{H_2} + \mathrm{V}_{O_2} + \mathrm{V}_{H_2O} + \mathrm{V}_{inert}$

5.5.2 SPEED OF SOUND

Speed of sound in various gases.

O_2 = 320 m/sec

AIR = 343 m/sec

H_2 = 1240 m/sec

steam: $H_2O_{(g)}$ = 450-600 m/sec

As the COMBUSTION cycle repeats, the gas mixture varies.

The speed of sound in the mix should have a variable speed within predictable limits.

This variable speed of sound produces a variable acoustic frequency given any fixed wavelength (acoustic mode) and acts as an interface to the user.

5.5.3 MOLAR

Molar analysis of gas mixture.

$$6V_N = 4V_{H_2O} + 2V_{O_2} \tag{5.5}$$

During combustion these six molar units re-combine into four molar units.

$$6V_N -> 4Nmols \tag{5.6}$$

Note 1: The volume $2V_N$ represents the moles O_2 created during electrolysis, increasing total moles thereby total pressure by 3/2.

Note 2: The volume $2V_N$ also represents the moles H_2O created after electrolysis upon combustion.

Heat release of this exothermic reaction is ≈ 232 kJ/mol.

$$P_{total} = P_{H_2O} + P_{O_2} + P_{H_2O(g)} + P_{inert} \tag{5.7}$$

N_{max} MOLES ALTOGETHER IN MIX OF VOLUME 6V

$$P_{eq} = \frac{N_{max}RT}{6V_N} \tag{5.8}$$

where V_N = 10x10x10 cubit$^3 \approx 144$ m^3

5.6 REFERENCE CHAMBER

THe REFERENCE CHAMBER acts as reference potential for liquid water and elecric potential.

During electrolysis the number of gas moles increases by a maximum factor of 3/2.

At isotherm conditions this is a maximum 3/2 increase in pressure.

At isobar conditions this is a maximum 3/2 increase in temperature.

Any pressure increase can push against liquid water at reference level back into the REFERENCE CHAMBER, or against the exposed REGULATOR.

5.6.1 EXCHANGER

The EXCHANGER provides waste material exchange in the REFERENCE CHAMBER via a niche in the east wall.

GAS EXCHANGE

The REFERENCE CHAMBER receives trapped gas from the SUBCHAMBER poppet valve.

PARTICULATES

Smaller particulates escape the REFERENCE CHAMBER for discharge via the SUBCHAMBER to the DRAIN.

5.7 OPERATION

COLD and WARM STARTS.

5.7.1 INITIALIZING

Initialization procedures.

COLD START

During a COLD START the TRANSMITTER is considered filled with ambient air, an oxygen-nitrogen gaseous mix.

Once the MOAT supplies the IMPULSE system with water operation begins, and the upper chambers are flooded with liquid water purging all gas through the SIGNAL GUIDES (except for the pressurized cushion below the TUNING SLABS).

Energy added to this liquid water eventually boils the water into steam.

This begins a WARM START.

WARM START

Warm start begins with the TRANSMITTER filled with $100^{\circ C}$steam around 1 ATM of pressure.

The available energy in the steam facilitates gas production (electrolysis) at the ANODE of the RESONANT CHAMBER and the CATHODE of the REFERENCE CHAMBER.

Hydrogen gas is produced at the CATHODE and oxygen gas

at the ANODE.

The differing densities of the gases (including the steam) sort the mixture by gravity.

In steam hydrogen rises and oxygen falls.

Between the COMBUSTION CHAMBER and RESONANCE CHAMBER is the IGNITION system.

Energy added to the system increases pressure and temperature under conditions necessary for IGNITION are met at the IGNITOR.

The IGNITOR provides ACTIVATION ENERGY for the recombination of gases into liquid water, reducing temperature and pressure.

This cycle continues through nominal operation.

5.8 VOLTAGE

The natural voltage gradient of the earth results from gravitational effect on electrons (negative charge carriers).

This voltage gradient varies by weather and other factors but is on the order of 125 Volts per meter in altitude.

The earth and the ionosphere are good conductors so the potential on either GUIDE will be considered the same.

$$E_{\oplus} = 125\frac{V}{m} \tag{5.9}$$

$$V_{\oplus} = E_{\oplus}d \tag{5.10}$$

5.8.1 CONTACT

The GUIDES open to atmospheric electric potential at a height of 80 m.

These equations halve that for no obvious reason.

$$d = 40m \tag{5.11}$$

$$V_\oplus = (125\frac{V}{m})(40m) \tag{5.12}$$

$$V_\oplus = 5000V \tag{5.13}$$

5.9 IMPEDANCE

Electric current travels through the body of the TRANSMITTER along a path of many materials with varying impedances.

These impedances are summed as

$$Z_x = Z_f + iZ_i \tag{5.14}$$

and can be evaluated along real and complex domains involving direct and time-varying currents.

5.10 CURRENT

For real impedance only, consider $Z_i = 0$.

$$I = \frac{V_E}{Z_f} \tag{5.15}$$

$$I = \frac{5000}{Z_f} \tag{5.16}$$

Assume real impedance Z_f equals one Ohm.

$$I = \frac{5000}{1} \tag{5.17}$$

$$I = 5000A \tag{5.18}$$

This current is measured in Coulombs per second of charge (that is, Amperes).

5.11 ELECTRONS

A Coulomb is equal to 6.24×10^{18} electrons.

$$C = 6.24 \times 10^{18} electrons/Coulomb \tag{5.19}$$

and the total number of electrons moving per second becomes

$$N_e = \frac{CV_E}{Z_f} \tag{5.20}$$

$$N_e = 5000C/s6.24 \times 10^{18} electrons/Coulomb \tag{5.21}$$

$$N_e = 3.12 \times 10^{22} electrons/sec \tag{5.22}$$

This is for reference impedance $Z_f = 1\ \Omega$

5.12 ELECTROLYSIS

Electrolysis is the process of using electrical energy to decompose water into hydrogen and oxygen.

This can be done with water in its liquid phase but is more efficient with water in its gaseous phase (steam).

5.12.1 ELECTROLYTE

NITRIC ACID generated by electrochemical process acts as an electrolyte facilitating electrolysis.

Other species like ammonia may also be produced.

Platinum or gold electrodes are recommended to resist corrosion and for low electrical resistance.

5.12.2 REACTION

GAS GENERATION

$$2H_2O ==> O_{2(g)} + 4H^+ + 4e^- \tag{5.23}$$

$$4H_2O + 4e^- ==> 2H_{2(g)} + 4OH^- \tag{5.24}$$

Add equations together:

$$2H_2O+4H_2O+4e^- ==> 2H_{2(g)}+O_{2(g)}+4H^++4OH^-+4e^- \tag{5.25}$$

$$6H_2O ==> 2H_{2(g)} + O_{2(g)} + 4H^+ + 4OH^- \tag{5.26}$$

$$6H_2O ==> 2H_{2(g)} + O_{2(g)} + 4H_2O \tag{5.27}$$

$$2H_2O ==> 2H_{2(g)} + O_{2(g)} \tag{5.28}$$

To summarize, for every four electrons of current flow one molecule of O_2 and two molecules of H_2 are produced, at the ANODE and CATHODE respectively.

5.13 HYDROGEN

Define α_H as the Hydrogen gas molecules (H_2) created per electron in electrolysis.

$$\alpha_H = 2molecules/4electrons = 0.5 \tag{5.29}$$

These equations calculate the hydrogen produced by electrolysis.

5.13.1 QUANTITY

The rate of hydrogen gas (H_2) production is therefore the electron flow times this production constant:

$$N_H = \alpha_H C \frac{V_E}{Z_f} \tag{5.30}$$

$$N_H = (\frac{molecule_{H_2}}{2e})(3.12 \times 10^{22} e/s) \tag{5.31}$$

$$N_H = 1.56 \times 10^{22} molecule_{H_2}/s \tag{5.32}$$

5.13.2 AMOUNT

There are 6.02×10^{23} molecules of hydrogen gas per mole. This is Avogadro's constant A_v.

The molar amount of hydrogen produced is given by

$$M_H = \frac{\alpha_H C V_E}{A_v Z_f} \tag{5.33}$$

$$M_H = \frac{1.56 \times 10^{22} molecule_{H_2}/s}{6.02 \times 10^{23} molecules/mole} \tag{5.34}$$

$$M_H = 0.0259 = 25.9 \times 10^{-3} mole_{H_2}/s \tag{5.35}$$

Or about one mole every forty seconds.

5.13.3 VOLUME

The density of any gas at STP is 22.4 L/mol however this condition is not constant inside the COMBUSTION CHAMBER.

This density will be considered a dynamic variable δ_H.

Ignition conditions:

$$T_i g = 375^{\circ C} = 648 \deg^K \tag{5.36}$$

$$P_i g = 10 bar = 1 MPa \tag{5.37}$$

The volume of hydrogen produced is the number of moles produces multiplied by δ_H

$$V_H = \delta_H \frac{\alpha_H C V_E}{A_v Z_f} \tag{5.38}$$

5.13.4 PRODUCTION

Calculate the volumetric rate of gas production.

Begin with ideal gas law:

$$PV = nRT \tag{5.39}$$

$$V = \frac{nRT}{P} \tag{5.40}$$

$$V = \frac{(0.0259mol/s)(8.314Pam^3/Kmol)(648\deg^K)}{1 \times 10^6 Pa} \tag{5.41}$$

$$V_h = 140 \times 10^{-6} m^3/s \tag{5.42}$$

5.13.5 FILL TIME

$$T_{fill} = 4V_N/V_h = \frac{4 \times 144m^3}{(140 \times 10^{-6} m^3/s)} \tag{5.43}$$

$$T_{fill} = 4.11 \times 10^6 sec \approx= 48days \tag{5.44}$$

5.14 OXYGEN

Similar calculations can be performed to the oxygen side of production.

5.15 CATHODE

The CATHODE is a lined vertical shaft at the junction of the REGULATOR and the COMBUSTION CHAMBER.

Hydrogen gas emerges here during electrolysis.

The CATHODE is grounded electrically to the REFERENCE CHAMBER along a conductive horizontal shaft.

This shaft has a 1 palm step located one cubit from its southern end then opens into the REFERENCE CHAMBER.

The step confines particulates for removal by the EXCHANGER.

5.16 ANODE

Electrons can reach the higher potential of the ionosphere at the GUIDE altitude traveling through the body of the TRANSMITTER via slightly conductive ionized water coursing through it.

They emit via outlets of each GUIDE at the TRANSMITTER surface.

This flow of negative particles out of the TRANSMITTER can also be considered a flow of positive particles into the device.

5.17 CAPACITY

The capacity of the COMBUSTION CHAMBER is four times the unit volume V_N.

$$V_{CC} = 4 \times V_N \tag{5.45}$$

5.18 CYCLE TIME

For the produced hydrogen to displace the original volume in the COMBUSTION CHAMBER its volume is divided by the production rate.

$$T_{fill} = \frac{4V_N}{\delta_H \frac{\alpha_H C V_E}{A_v Z_f}} \tag{5.46}$$

$$T_{fill} = \frac{4V_N A_V Z_f}{\alpha_H \delta_H C V_E} \tag{5.47}$$

To the first order this is

$$T_{fill} \sim= Z_f \times \frac{10^1 10^5 10^{23}}{10^1 10^2 10^{18} 10^3} \tag{5.48}$$

$$T_{fill} \sim= Z_f \times 10^5 seconds \tag{5.49}$$

That is, reasonable cycle times require low resistance back to ground potential.

5.19 STEAM

This cycle can be adjusted by controlling the energy input from the IMPULSE (that is, regulating IMPULSE output modulates IGNITION cycle).

5.19.1 TEMPERATURE

Temperature of the gaseous mix is T(t), an aperiodic function due to thermal inertia.

5.19.2 PRESSURE

Pressure of the gaseous mix is P(t), a periodic function with a cycle greater than that of the IMPULSE.

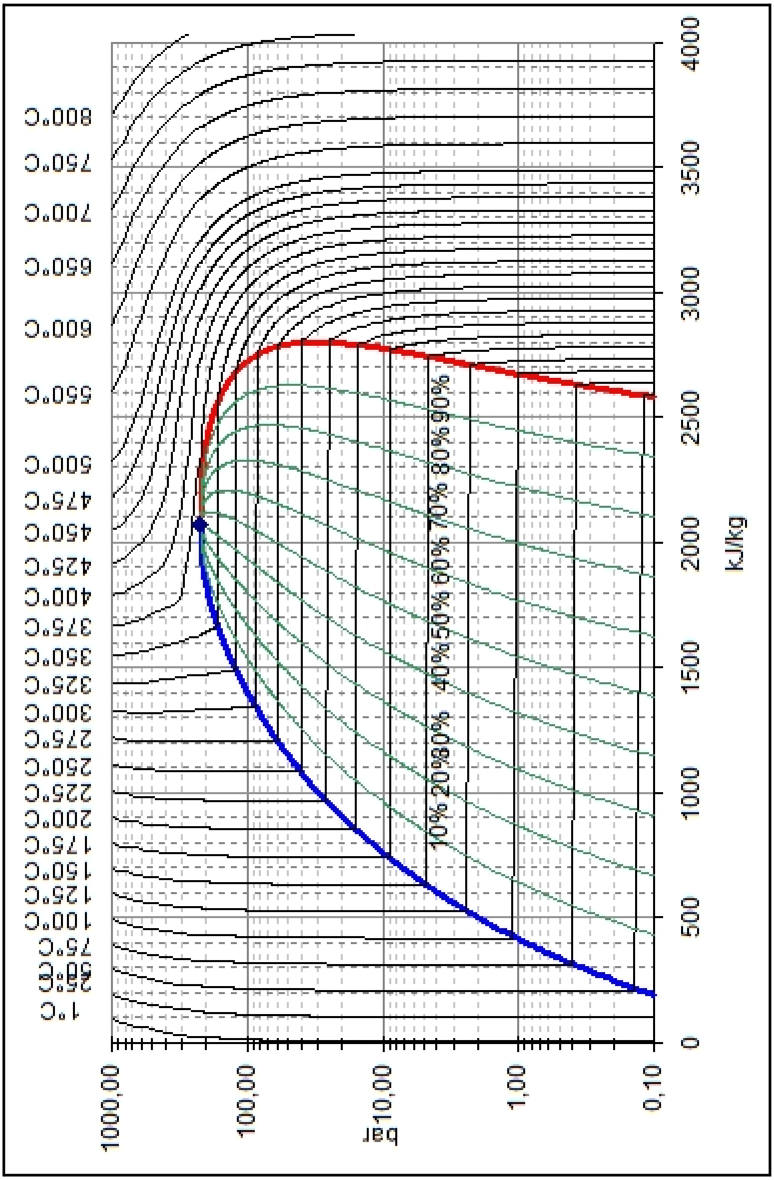


Figure 5.2: STEAM CHART

Chapter 6

FIRE

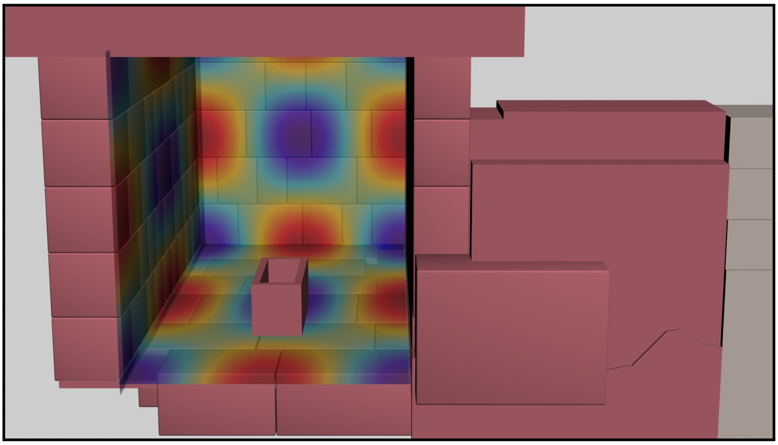


Figure 6.1: MAIN FIRE

The TRANSMITTER ignites accumulated hydrogen and oxygen.

6.1 GENERAL

At proper conditions of temperature and pressure the accumulated electric charge of current flow through the device forces the IGNITOR mechanism to physically discharge into

the hydrogen/oxygen mixture.

A track of the thermodynamic path through steam is shown in Figure 5.2.

6.2 IGNITOR

The IGNITOR is an electromechanical assembly located between the RESONANCE CHAMBER and the COMBUSTION chamber.

The IGNITOR includes a built-in capacitor with mobile plates. As current flows, charge builds on the capacitor until electrostatic attraction displaces the plates. This narrows the gap between them eventually generating an arc in the form of a spark.

The physical change enables the IGNITOR to retract inside the IGNITOR HOUSING providing unblocked access between the oxygen reservoir inside the RESONANCE CHAMBER and the hydrogen reservoir inside the COMBUSTION CHAMBER.

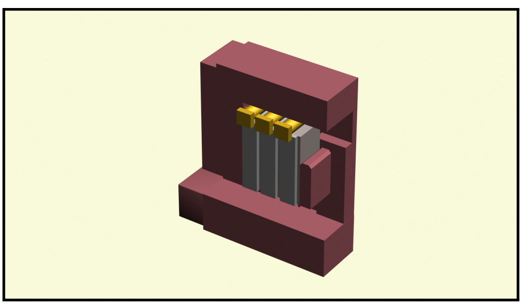


Figure 6.2: IGNITOR OPEN

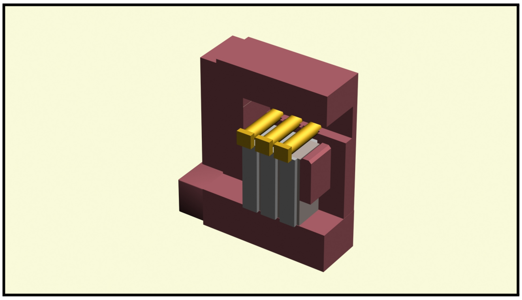


Figure 6.3: IGNITOR CLOSED

6.3 ACTIVATION ENERGY

This discharge provides activation energy required to ignite the hydrogen and begin combustion.

6.4 COMBUSTION TIME

Combustion is estimated to be on the order of one cyc;e.

$$T_{combust} = 1cycle \tag{6.1}$$

6.5 PRESSURE

Combustion results in a pressure change throughout the upper chambers.

$$\Delta P = 10bar = 1MPa = 1 \times 10^6 N/m^2 \tag{6.2}$$

6.5.1 ACOUSTICS

The pressure change produces an acoustic stimulation to the RESONANCE CHAMBER.

DECIBELS

The pressure change can be expressed as an acoustic value by converting to decibels.

6.6 TEMPERATURE

Due to thermal inertia the chamber walls will heat/cool slower than the gases of combustion.

6.7 REACTION

Reaction estimates.

6.7.1 ENERGY

During combustion 232kJ/mol of energy is released.

Maximum energy output is limited by capacity of gas reservoirs.

$$E = \frac{(144000L)(232kJ/mol)}{22.4L/mol} \tag{6.3}$$

$$E = 1.5 \times 10^9 J \tag{6.4}$$

If combustion takes 1 second this equals 1.5 GW available for pressure, heat, and light.

$$P_{reaction} = 1.5 \times 10^9 W \tag{6.5}$$

6.7.2 RADIO POWER

Radio power is reaction power times transfer efficiency from acoustically coupled EM waves, estimated at 10%.

$$P_{rf} = 0.1 * 1.5 \times 10^9 W = 150MW \tag{6.6}$$

$$P_{rf} = 150 \times 10^6 W \tag{6.7}$$

Chapter 7

LIGHT

The nature of light allows using its wavelength as a measuring tool.

Radio astronomy offers advantages over visual astronomy with certain observations.

7.1 GENERAL

Once the cyclic reaction begins it accelerates to the point where radiant loss into the structure and out of the structure equals the dissolution energy of the injected water pulse.

7.2 COLOR

Calculate joules per molecule:

$$232kJ/A_v = 3.853x10^-19J/molecule_{H_2O} \tag{7.1}$$

Calculate wavelength:

$$\lambda = hc/E \tag{7.2}$$

$$\lambda = \frac{(6.626 \times 10^{-34} Js)(2.998 \times 10^8 m/s)}{(3.853 \times 10^{-19} J)} \tag{7.3}$$

$$\lambda = 515.6nm \tag{7.4}$$

The reaction results in blue-green light and heat.

7.3 TUNING LEAVES

The TUNING LEAVES are granite slabs suspended over the RESONANCE CHAMBER that respond to the RESONATOR while in resonance.

Five strata arrange the TUNING LEAVES to modulate signal resonance.

These strata also interact with the acoustic user interface.

7.4 RESONANCE CHAMBER

Thermal momentum in the granite walls of the RESONANCE CHAMBER gradually heats them, enhancing their natural piezoelectric properties.

Combustion results in energy available as sound pressure, light, and heat.

The pressure wave from combustion produces an acoustic standing wave in the walls of the tuned RESONANCE CHAMBER. These standing waves appear in dynamic piezoelectric waves, wavelength for wavelength, in the electromagnetic spectrum albeit at a higher wave-speed.

These couplings match the speed of light with the speed of sound.

7.4.1 DIMENSIONS

CHAMBER DIMENSIONS

(m)	Length	Width	Height
inner	5.236	10.47	5.85
(rc)	Length	Width	Height
inner	10	20	11.17 ($5\sqrt{5}$)

LENGTH

$$L_{RC} = 5.24m = 10cubits \tag{7.5}$$

WIDTH

$$W_{RC} = 10.47m = 20cubits \tag{7.6}$$

AREA

$$A_{RC} = 2x10x20 + 2x10x5\sqrt{5} + 2x20x5\sqrt{5} \tag{7.7}$$

$$A_{RC} = 1070.8rc^2 = 293.6m^2 \tag{7.8}$$

HEIGHT

$$H_{RC} = 5.85m = 11.2cubits \tag{7.9}$$

VOLUME

$$V_{RC} = 10x20x5\sqrt{5}rc^3 = 2236rc^3 = 320.7m^3 \tag{7.10}$$

7.4.2 GRANITE SOUND

Calculate speed of sound in granite as square root of bulk modulus divided by density. This might change significantly at reaction temperatures.

$$v_{granite} = \sqrt{\frac{B}{\rho_{granite}}} \tag{7.11}$$

$$v_{granite} = \sqrt{\frac{50 \times 10^9 Pa}{2700 kg/m^3}} \tag{7.12}$$

$$v_{granite} = 4.3 \times 10^3 \frac{m}{s} \tag{7.13}$$

7.4.3 REVERBERATION

Where V is volume and S is surface area, an estimate of the reverberation time RT60 derives from the Sabine equation using absorption coefficient a=0.01.

$$RT60 = 24ln(10)cVaS \tag{7.14}$$

At $20^{\circ C}$the speed of sound in air is c=343m/s

$$RT60 = 0.161321(0.01)(294) \tag{7.15}$$

$$RT60 = 17.6s \tag{7.16}$$

This value should compensate for reaction temperature and pressure but provides a good estimate.

7.5 ACOUSTIC MODES

The RESONANCE CHAMBER supports acoustic standing modes.

Different modes resonate at different magnitudes.

7.5.1 AXIAL

AXIAL MODES are strongest modes.

AXIAL MODE HEIGHT

$$f_{resonance} = \frac{v}{2}\sqrt{(\frac{h}{H})^2} \tag{7.17}$$

where H is the height (top-bottom) of the RESONANCE CHAMBER.

$$f_{resonance} = \frac{v}{2}\sqrt{(\frac{l}{5.849})^2} \tag{7.18}$$

The lowest mode is for h = 1.

$$f_{resonance} = \frac{v}{2}\sqrt{(\frac{1}{5.849})^2} \tag{7.19}$$

$$f_{resonance} = 0.08548v \tag{7.20}$$

$$f = \frac{1}{\lambda}v \tag{7.21}$$

$$\lambda = 11.70m \tag{7.22}$$

For oxygen in the chamber $v = 330m/s$ therefore

$$f_{oxygen} = 28.2Hz \tag{7.23}$$

For hydrogen in the chamber $v = 1280m/s$ therefore

$$f_{H_2} = 109Hz \tag{7.24}$$

For steam in the chamber $v = 500m/s$ therefore

$$f_{steam} = 42.7Hz \tag{7.25}$$

And the induced EM wave

$$f_{em} = 3 \times 10^8 m/s/7.31m = 25.6MHz \tag{7.26}$$

AXIAL MODE LENGTH

$$f_{resonance} = \frac{v}{2}\sqrt{(\frac{l}{L})^2} \tag{7.27}$$

where L is the length (north-south) of the RESONANCE CHAMBER.

$$f_{resonance} = \frac{v}{2}\sqrt{(\frac{l}{5.236})^2} \tag{7.28}$$

The lowest mode is for l = 1.

$$f_{resonance} = \frac{v}{2}\sqrt{(\frac{1}{5.236})^2} \tag{7.29}$$

$$f_{resonance} = 0.09549v \tag{7.30}$$

$$f = \frac{1}{\lambda}v \tag{7.31}$$

$$\lambda = 10.47m \tag{7.32}$$

For oxygen in the chamber $v = 330m/s$ therefore

$$f_{oxygen} = 31.5Hz \tag{7.33}$$

For hydrogen in the chamber $v = 1280m/s$ therefore

$$f_{H_2} = 122Hz \tag{7.34}$$

For steam in the chamber $v = 500m/s$ therefore

$$f_{steam} = 47.7Hz \tag{7.35}$$

And the induced EM wave

$$f_{em} = 3 \times 10^8 m/s/7.31m = 28.6MHz \tag{7.36}$$

AXIAL MODE WIDTH

$$f_{resonance} = \frac{v}{2}\sqrt{(\frac{w}{W})^2} \tag{7.37}$$

where W is the width (east-west) of the RESONANCE CHAMBER.

$$f_{resonance} = \frac{v}{2}\sqrt{(\frac{w}{10.472})^2} \tag{7.38}$$

The lowest mode is for w = 1.

$$f_{resonance} = \frac{v}{2}\sqrt{(\frac{1}{10.472})^2} \tag{7.39}$$

$$f_{resonance} = 0.04775v \tag{7.40}$$

$$f = \frac{1}{\lambda}v \tag{7.41}$$

$$\lambda = 20.94m \tag{7.42}$$

For oxygen in the chamber $v = 330m/s$ therefore

$$f_{oxygen} = 15.8Hz \tag{7.43}$$

For hydrogen in the chamber $v = 1280m/s$ therefore

$$f_{H_2} = 61.1Hz \tag{7.44}$$

For steam in the chamber $v = 500m/s$ therefore

$$f_{steam} = 23.9Hz \tag{7.45}$$

And the induced EM wave

$$f_{em} = 3 \times 10^8 m/s/7.31m = 14.3MHz \tag{7.46}$$

7.5.2 TANGENTIAL

$$f_{resonance} = \frac{v}{2}\sqrt{(\frac{l}{L})^2 + (\frac{w}{W})^2} \tag{7.47}$$

where L and W are the length and width RESONANCE CHAMBER.

$$f_{resonance} = \frac{v}{2}\sqrt{(\frac{l}{5.236})^2 + (\frac{w}{10.47})^2} \tag{7.48}$$

The lowest mode is for l = w = 1.

$$f_{resonance} = \frac{v}{2}\sqrt{(\frac{1}{5.236})^2 + (\frac{1}{10.47})^2} \tag{7.49}$$

$$f_{resonance} = 0.1068v \tag{7.50}$$

$$f = \frac{1}{\lambda}v \tag{7.51}$$

$$\lambda = 9.366m \tag{7.52}$$

For oxygen in the chamber $v = 330m/s$ therefore

$$f_{oxygen} = 35.2Hz \tag{7.53}$$

For hydrogen in the chamber $v = 1280m/s$ therefore

$$f_{H_2} = 137Hz \tag{7.54}$$

For steam in the chamber $v = 500m/s$ therefore

$$f_{steam} = 53.4Hz \tag{7.55}$$

And the induced EM wave

$$f_{em} = 3 \times 10^8 m/s/7.31m = 32.0MHz \tag{7.56}$$

7.5.3 OBLIQUE

Weakest of all room modes.

$$f_{resonance} = \frac{v}{2}\sqrt{(\frac{l}{L})^2 + (\frac{w}{W})^2 + (\frac{h}{H})^2} \tag{7.57}$$

where L, W, and H are the length width and height of the RESONANCE CHAMBER.

$$L = 5.236m = 10rc \tag{7.58}$$

$$W = 10.47m = 20rc \tag{7.59}$$

$$H = 5.85m = 11.17rc \tag{7.60}$$

$$f_{resonance} = \frac{v}{2}\sqrt{(\frac{l}{5.236})^2 + (\frac{w}{10.47})^2 + (\frac{h}{5.85})^2} \tag{7.61}$$

The lowest mode is for l = w = h = 1.

$$f_{resonance} = \frac{v}{2}\sqrt{(\frac{1}{5.236})^2 + (\frac{1}{10.47})^2 + (\frac{1}{5.85})^2} \tag{7.62}$$

$$f_{resonance} = 0.1368v \tag{7.63}$$

For oxygen in the chamber $v = 330m/s$ therefore

$$f_{oxygen} = 45.1Hz \tag{7.64}$$

$$\lambda_{oxygen} = 7.3m \tag{7.65}$$

For hydrogen in the chamber $v = 1280m/s$ therefore

$$f_{H_2} = 175Hz \tag{7.66}$$

$$\lambda_{H_2} = 7.3m \tag{7.67}$$

For steam in the chamber $v = 500m/s$ therefore

$$f_{steam} = 68.4Hz \tag{7.68}$$

$$\lambda_{steam} = 7.3m \tag{7.69}$$

And the induced EM wave

$$f_{em} = 3 \times 10^8 m/s/7.31m = 41.0MHz \tag{7.70}$$

7.6 RESONATOR

The GRANITE BOX produces reference tones by its physical shape stimulated by acoustic pressure.

The proportions of this RESONATOR match the dimensions of the RESONATOR in the RECEIVER.

These serve as resonating transducers.

RESONATOR DIMENSIONS

(mm)	Length	Width	Height
inner	1982.7	681.0	874.3
outer	2276.3	978.0	1049.3

7.6.1 VOLUMES

INNER

$$V_{inner} = 1.983x0.681x0.8743 = 1.1805m^3 \tag{7.71}$$

OUTER

$$V_{outer} = 2.276x0.978x1.0493 = 2.3357m^3 \tag{7.72}$$

$$ratio\frac{V_{inner}}{V_{outer}} = \frac{1.1805}{2.3357} = 0.5054 \tag{7.73}$$

The lowest mode is for l = w = h = 1.

$$f_{resonance} = \frac{v}{2}\sqrt{(\frac{1}{1.983})^2 + (\frac{1}{0.681})^2 + (\frac{1}{0.8743})^2} \tag{7.74}$$

$$f_{resonance} = 0.9642v \tag{7.75}$$

For oxygen in the chamber $v = 330m/s$ therefore

$$f_{oxygen} = 318Hz \tag{7.76}$$

$$\lambda_{oxygen} = 1.0377m \tag{7.77}$$

For hydrogen in the chamber $v = 1280m/s$ therefore

$$f_{H_2} = 1234Hz \tag{7.78}$$

$$\lambda_{H_2} = 1.0373m \tag{7.79}$$

7.6.2 BOX TO CHAMBER

$$V_{RESONATOR} = 2.3357m^3 \tag{7.80}$$

$$V_{RC} = 320m^3 \tag{7.81}$$

$$ratio\frac{V_{RES}}{V_{RC}} = \frac{2.3357}{320} = 0.0073 = 1/137.0039 \tag{7.82}$$

7.6.3 FREQUENCIES

$$f = \frac{v}{2\lambda} \tag{7.83}$$

$$f = \frac{4300m/s}{2(1.0493m)} \tag{7.84}$$

$$f = 2045Hz \tag{7.85}$$

7.7 LEAVES

$$A_{RC} = 54.83m^2 \tag{7.86}$$

Maximum force on the ceiling LEAVES is the area times the maximum pressure.

Max pressure 200 ATM = 20.3 MPa

Nominal pressure force is twice weight of entire ceiling.

$$F_{RCroof} = (20.3 \times 10^6 \frac{N}{m^2})(54.83m^2) = 1.11 \times 10^9 N \tag{7.87}$$

There are nine TUNING LEAVES, assuming even distribution

$$F_{slab} = 1.11 \times 10^9 N/9 = 124MNperSLAB \tag{7.88}$$

Each slabs at 70 tons = 63503 kg = 63.5 mt

Nine slabs are 571mt = 5.6 MN

Forty-one slabs are 230 GN

Maximum pressure is 4.2 GPa (blow-apart pressure).

7.8 RADIO

The piezoelectric response of granite to the maximum pressure change is a ratio of charge per unit pressure:

$$\Gamma_g = 1.5 \times 10^{-12} \frac{C}{N} = 1.5 \times 10^{-12} \frac{V}{Nm^2} \tag{7.89}$$

This charge is distributed across the RESONANCE CHAMBER according to the pressure of standing acoustic waves.

To get a voltage multiply by surface area squared (**??**):

$$V_g = (A \times \Gamma_g)(A \times \Delta P) = A^2 \Gamma_g \Delta P \tag{7.90}$$

$$V_g = (300m^2)^2 (1.5 \times 10^{-12} \frac{V}{Nm^2})(6 \times 10^6 \frac{N}{m^2}) \tag{7.91}$$

$$V_g = 0.81V \tag{7.92}$$

The piezoelectric response of granite to temperature change is unknown.

7.9 EM MODES

Acoustic resonance stimulates standing waves of piezoelectric charge along a granite surface, producing simultaneous identical wavelengths in the acoustic and electromagnetic spectra.

7.9.1 WAVELENGTH COUPLED ACOUSTIC EM

$$\lambda_{em} = 7.31m \tag{7.93}$$

7.9.2 FREQUENCY

$$f_{em} = 3 \times 10^8 m/s/7.31m = 41.0MHz \tag{7.94}$$

7.9.3 COUPLED POWER

Power transfer efficiency from reaction energy coupled acoustically to EM waves estimated at 10%.

Acoustically coupled power is 0.10 * 1.5 GW = 150 MW

7.10 CAVITY

A CAVITY resonator located in the south wall of the RESONANCE CHAMBER generates a microwave signal when modulated by the acoustically coupled RF energy.

The CAVITY is tapped by the WAVEGUIDE for output.

The CAVITY is located 1.05m above the floor 2.49m from the east wall.

7.10.1 SIGNAL POWER

CAVITY power transfer efficiency from acoustically coupled EM waves estimated at 1%.

Maximum output power is radio signal power gain multiplied by the CAVITY transfer efficiency.

$P_{min} = acoustic\ power*$
$acoustically\ coupled\ efficiency$

$$cavity\ efficiency \tag{7.95}$$

$$P_{min} = 0.01 * 150MW = 1.5MW \tag{7.96}$$

$$P_{min} = 1.5 \times 10^6 W \tag{7.97}$$

FREQUENCY

The CAVITY is tuned to the signal frequency.

$$f_{signal} = 1420 \times 10^6 Hz \tag{7.98}$$

WAVELENGTH

Wavelength is speed of light divided by frequency.

$$\lambda_{resLC} = \frac{f_{resLC}}{c} \tag{7.99}$$

$$\lambda_{resLC} = \frac{3.0 \times 10^8 m/s}{1420 \times 10^6 s^{-1}} \tag{7.100}$$

$$\lambda_{resLC} = 21cm \tag{7.101}$$

7.11 WAVEGUIDE

A thin sheet of liquid water expelled from the waveguide provides a conducive surface along the length of the waveguide.

7.11.1 LOSS

Waveguide loss is given at 2.5dBW.

Chapter 8

SIGNAL

The purpose of the TRANSMITTER is to transmit the SIGNAL

8.1 ANTENNA

GUIDES act as antenna in two modes: Longitudinal for FM world band and Transverse Mode for microwave SIGNAL.

8.1.1 CASING

The core and casing act as dielectrics insulated from the signal output.

8.1.2 CLOUD

Output RF power tapped by CAVITY is brought to TRANSMITTER surface by southern GUIDE CHANNEL.

The condensing ionized exhaust cloud acts as ANTENNA. Charge is returned via the TRANSMITTER and the RECEIVER.

The TRANSMITTER acts as a transit device, using the rotation of the Earth to bring radar targets into range.

8.1.3 BEAM

GAIN

Figure 8.1: BEAM

8.1.4 EIRP

Where all are in dB

$$EIRP = P_T + G_T - L \tag{8.1}$$

8.2 LATITUDE

Latitude of TRANSMITTER output is approximately but not exactly 30 degrees.

8.3 ANGLE

Angle of output beam is 5-60 degrees.

8.4 ROTATION

TRANSMITTER rotates once per sidereal day.

8.5 MODULATION

Resonance of TUNING LEAVES frequency modulates the standing RF waves.

Distinctive characteristics of modulation can be used at the RECEIVER to distinguish signal from noise.

Part II

RECEIVER

Chapter 9

SIZE

A sphere can store one value, in its radius. A pyramid with square base can store two values, in its base length and in its height.

The TRANSMITTER stores radius of the Earth redundantly in both base and height.

This redundancy highlights the accuracy found in the value and also specifies the constant of proportion to be used (in this case, K=43200).

Next planet nearest the sun is Earth's closest planetary neighbor, our sister world Venus.

When considering the RECEIVER to represent the planet Venus, the same constant of proportion can be used.

The base of the RECEIVER is 215.3m (411.2 cubits). The height of the RECEIVER is 143.5m (274.1 cubits).

Using the formula for the volume of a pyramid these values yield a volume of $2.217 \times 10^6\ m^3$.

The volume of the TRANSMITTER - representing the Earth

- can be similarly calculated as $2.594\times10^6\ m^3$.

The ratio of these values, $\frac{volume_{RECEIVER}}{volume_{TRANSMITTER}}$ is $\frac{2.217}{2.594} = 0.855$.

Given the volume of the Earth is $1.083\times10^{21}\ m^3$ and the volume of Venus is $9.284\times10^{20}\ m^3$.

The ratio of these values, $\frac{volume_{RECEIVER}}{volume_{TRANSMITTER}}$ is $\frac{9.284}{10.83} = 0.857$.

These two ratios are remarkably close, less than half of one percent apart.

The RECEIVER stands in volumetric proportion to the TRANSMITTER as the planet Venus does to the planet Earth.

The upscaled version of the radius of Venus using the height would be K $\times$ H_{VENUS} = 43200 $\times$ 143.5m = 6200km.

The upscaled version of the radius of Venus using the base would be K $\times$ $\frac{2\times B_{VENUS}}{\pi}$ = 43200 $\times$ $\frac{2\times 215.3m}{\pi}$ = 5920km.

These two values represent the outer bounds of the estimate: 6200km-5920km = 280km.

The average of these two values is (6200km+5920km)/2 = 6060km. The error range is divided evenly, resolving to 140km above or below the estimated value.

With the same method of encoding of the TRANSMITTER applied to the RECEIVER, the the radius of Venus is estimated at 6060$\pm$140km.

The current estimate of the space age is 6052$\pm$1km.

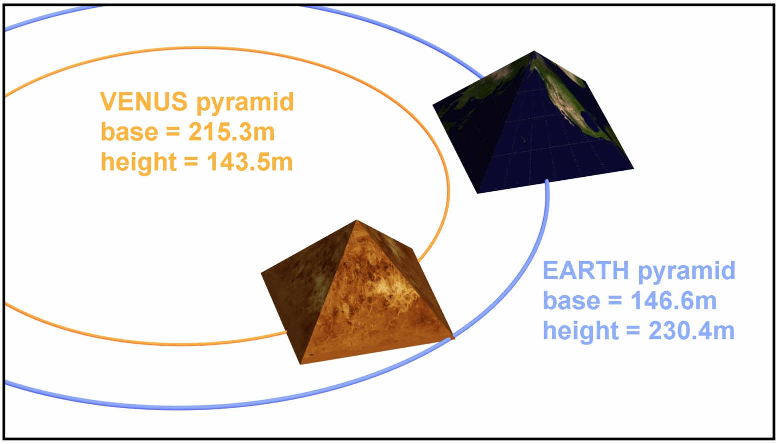


Figure 9.1: PLANET VOLUMES

9.1 GENERAL

The RECEIVER converts a reflected RF signal into data indicating the strength of the echo.

Target distance and velocity can be calculated by synchronizing the transmitting pulse with the received signal,

With sufficient technique other variables such as rotation rate, rotation axis, and surface profiles can be calculated.

The shape of the RECEIVER focuses returning RF energy to a transducer system below the device.

9.2 DIMENSIONS

The RECEIVER pyramid models the planet Venus as a primary target of the observatory.

9.2.1 EARTH

Materials for RCVR.

9.2.2 WATER

Materials for RCVR.

9.2.3 AIR

Materials for RCVR.

9.3 PROFILE

9.3.1 APERTURE

9.3.2 EFFECTIVE AREA

Given P_r available power at the output of the RECEIVER and S_r the power per unit area, of an incident field at the antenna. The effective aperture area of the antenna can be defined as

$A_e = \frac{P_r}{S_r}$

Power available at the output equals the incident power flowing through an area equal to the effective aperture area of the antenna.

$$P_r = S_r A_e \tag{9.1}$$

APERTURE EFFICIENCY

The dimensionless aperture efficiency of the RECEIVER is given as the ratio of its effective and physical aperture areas:

$$\eta = \frac{A_e}{A_{ph}} \tag{9.2}$$

$$\eta - 50 - 70 \tag{9.3}$$

9.4 ANTENNA

The dimensionless maximum antenna gain is given by

$$G_{MAX} = \frac{4\pi A_e}{\lambda^2} \tag{9.4}$$

9.4.1 DIRECTIVITY

Maximum directivity is given

$$D_{MAX} = \frac{4\pi A_{em}}{\lambda^2} \tag{9.5}$$

where λ is the wavelength and A_{em} is the maximum effective aperture area, related to Aem as

$$\eta_{rad} = \frac{A_e}{A_{em}} \tag{9.6}$$

where $0 <= \eta_{rad} <= 1$ and

$$\eta_{rad} = \frac{G_{MAX}}{D_{MAX}} \tag{9.7}$$

9.4.2 GAIN

The gain of a lossless antenna thus equals its directivity since $\eta_{rad} = 1$ in this case. This approximation can often be made when determining the gain of real world antennas.

The maximum antenna directivity is also given by the ratio of the maximum to the average power density of the antenna. It can be shown [79, ch. 2-8, 3-13] that this can be expressed as

$$D_{MAX} = \frac{4\pi}{\Omega_A} \tag{9.8}$$

The beam solid angle is defined as the solid angle through which all power from a transmitting antenna would flow, if the power per unit solid angle were constant and equal to its maximum value.

Equating eq. (3.4b) with eq. (3.6) and rearrange to get

$$\Omega_A = \frac{\lambda}{A_{em}} \tag{9.9}$$

9.4.3 APERTURE EFFICIENCY

The aperture efficiency can also be expressed as

$$\eta_{ap} = \eta_{rad} \frac{A_{em}}{A_{ph}} \tag{9.10}$$

The gain is given in decibels referenced to a lossless and spherically radiating (isotropic) antenna.

9.4.4 EIRP

Equivalent isotropic radiated power (EIRP) is defined as

$$EIRP = P_T G_T \tag{9.11}$$

where P_T is the power delivered to the terminals of a transmitting antenna and G_T its gain in the direction of the receiver.

Assuming an isotropically radiating transmitting antenna, that is $G_T = 1$, the power density at the receiving antenna is given by

$$S_r = \frac{P_T G_T}{4\pi r^2} \tag{9.12}$$

The power collected by the receiving antenna, as measured at its terminals, is

$$P_R = S_r A_{R.e} \tag{9.13}$$

then

$$P_R = \frac{P_T A_{T.e} A_{R.e}}{r^2 \lambda^2} \tag{9.14}$$

also

$$P_R = \frac{P_T G_T G_R \lambda^2}{(4\pi r)^2} \tag{9.15}$$

and finally

9.4.5 LOSS

$$P_R = \frac{EIRPG_R}{L_{fsl}} \tag{9.16}$$

using the free-space loss which is the ratio of the transmitted and received powers, given as

$$L_{fsl} = (\frac{4\pi r}{\lambda})^2 \tag{9.17}$$

This definition is in adherence to the nomenclature in this report, where a loss is always given as a number greater than unity, in linear terms.

9.4.6 RADAR EQUATION

The power density incident at the radar object (target) is

$$S_{obj} = \frac{P_T G_T}{4\pi r_T^2} \tag{9.18}$$

where r_T (m) is the distance from the TRANSMITTER to the radar object.

9.4.7 RADAR CROSS-SECTION

The physical properties of the radar object as well the frequency, polarization and angle of incidence of the radar signal, different amounts of power will be reflected in the direction of the receiving antenna. The radar cross section (RCS) σ is a function of these parameters such that the power density incident at the RECEIVER is given by

$$S_R = \frac{S_{obj}\sigma}{4\pi r_R^2} \tag{9.19}$$

where r_R is the distance from the radar object to the receiving antenna.

9.4.8 RECEIVED POWER

The power collected by the effective aperture area $A_{R.e}$ of the receiving antenna is now given by

$$P_R = S_R A_{R.e} \tag{9.20}$$

Inserting eqs. (3.18) and (3.19) into eq. (3.20) we get

$$P_R = \frac{P_T G_T}{4\pi r_T^2}\frac{S_{obj}\sigma}{4\pi r_R^2}A_{R.e} \tag{9.21}$$

$$P_R = \frac{P_T G_T \sigma A_{R.e}}{(4\pi)^2 r_T^2 r_R^2} \tag{9.22}$$

Rearranging to get the aperture area and insert to get the bistatic radar equation as

$$P_R = \frac{P_T G_T G_R \lambda^2 \sigma}{(4\pi)^3 r_T^2 r_R^2} \tag{9.23}$$

Assuming the TRANSMITTER and RECEIVER are at the same distance r from the radar object

$$P_R = \frac{P_T G_T G_R \lambda^2 \sigma}{(4\pi)^3 r^4} \tag{9.24}$$

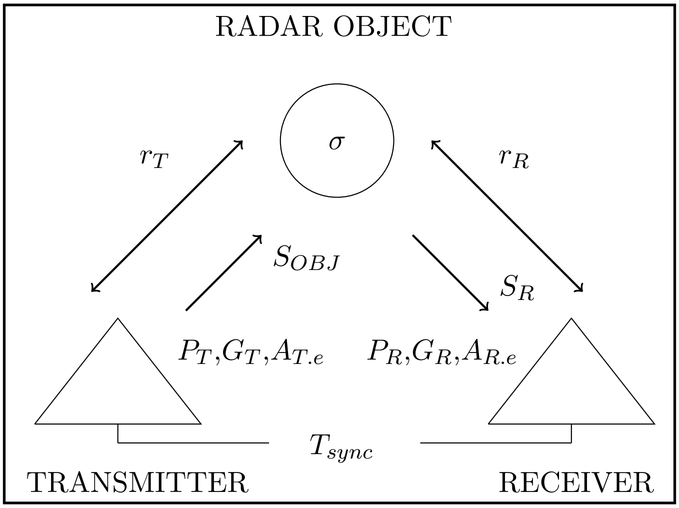


Figure 9.2: RADAR VARIABLES
RADAR COMMUNICATION LINK VARIABLES

9.5 TRANSDUCER

The modulated signal broadcast by the TRANSMITTER upon successful echo returns to the RECEIVER after a time delay twice the distance to the target divided by the speed of light.

At that point it must be significantly amplified, rectified from noise, and indicated via a visual or acoustic human interface.

9.5.1 CALIBRATION

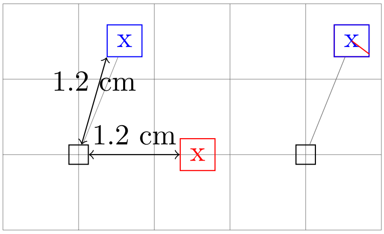
The RECEIVER TRANSDUCER may be mounted to the floor for additional calibration.

TRANSDUCER Dimensions

(mm)	Length	Width	Height
inner	1982.7	681.0	874.3
outer	2276.3	978.0	1049.3
(digits)	Length	Width	Height
inner	10603	3642	4675
outer	12173	5230	5611
(cubits)	Length	Width	Height
inner	3.787	1.301	1.670
outer	4.348	1.868	2.004

9.5.2 COUPLING MODES

Modes that couple between XMTR and RCVR Figure 9.2.



9.6 RADAR CONSTANTS

Venus factors:

9.6.1 RADIUS

radius of target

$$r_V = 6.10 \times 10^6 m \tag{9.25}$$

echo coefficient

$$\sigma_V = 0.1 \tag{9.26}$$

echo coefficient (area)

$$\sigma = \sigma_V r_V^2 = (0.1)\left(6.10 \times 10^6 m\right)\left(6.10 \times 10^6 m\right) \tag{9.27}$$

9.6.2 RCVR VARIABLES

9.6.3 CALCULATIONS

$$P_r = \frac{P_t \times G^2 \lambda^2}{(4\pi)^3 r^4} \tag{9.28}$$

$$\sigma = \sigma_V r_V^2 = 3.72 \times 10^{12} m^2 \tag{9.29}$$

Part III

OBSERVATORY

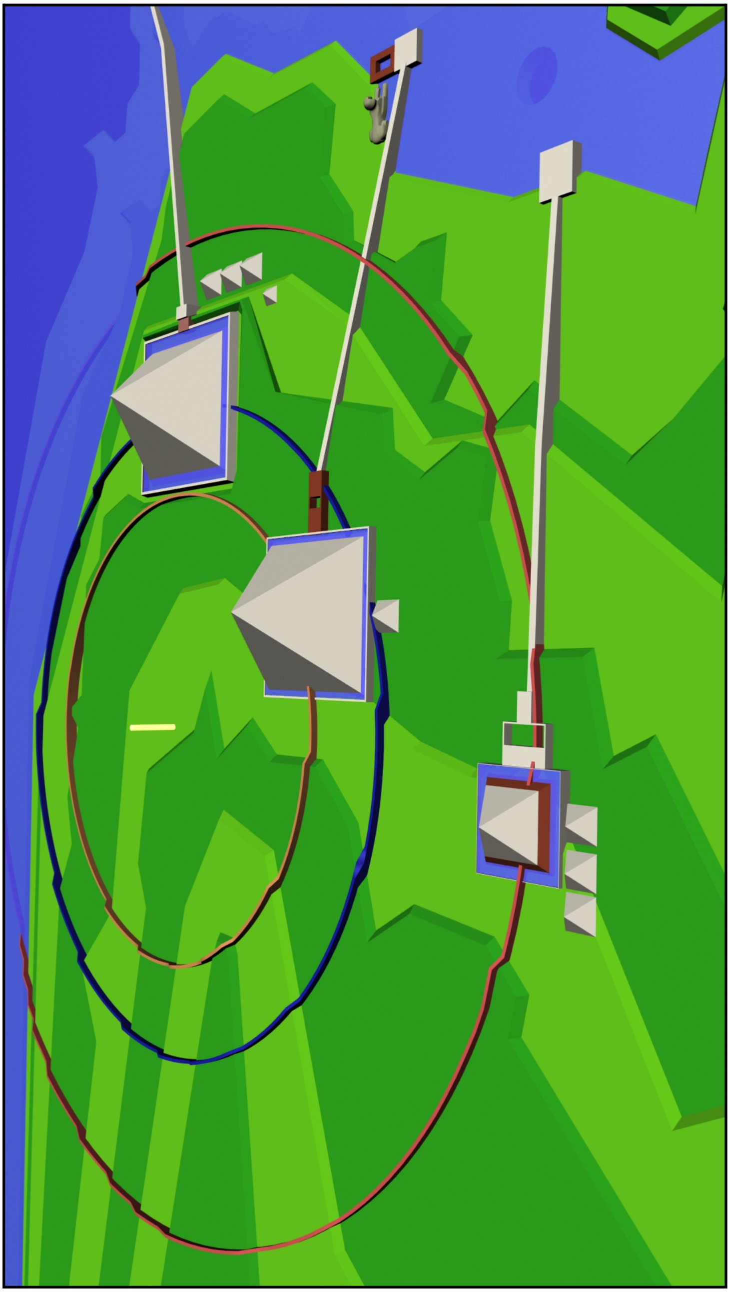


Figure 9.3: ORBITS

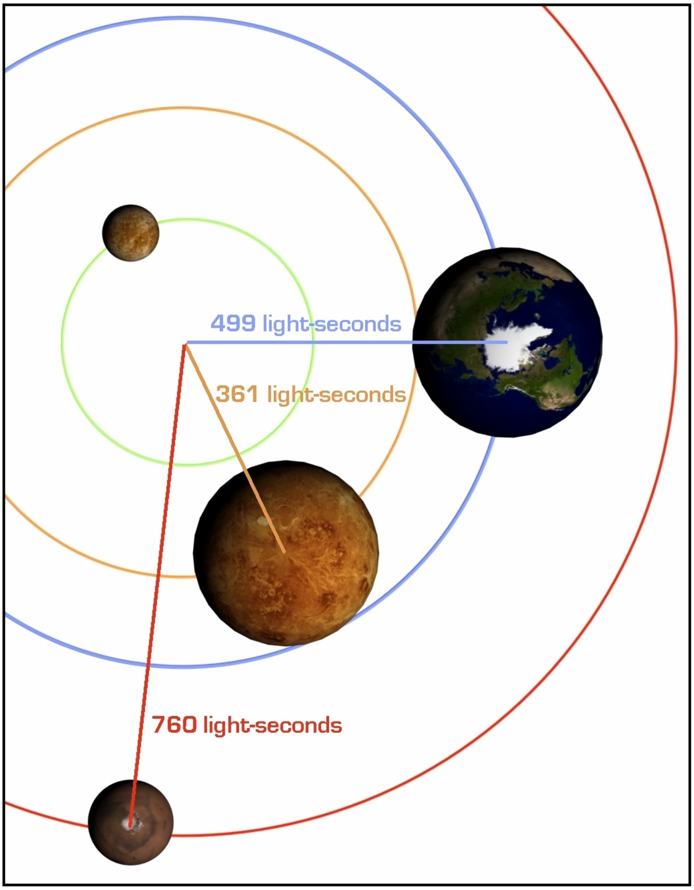


Figure 9.4: ORBITS LS

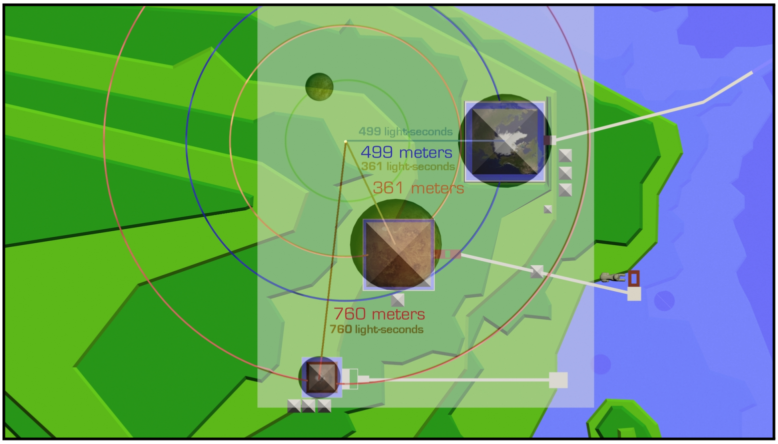


Figure 9.5: OVERLAY

Chapter 10

GENERAL

As an orrery the complex models the inner solar system. See appendix.

As a metronome the TRANSMITTER drives the entire complex, generating radio frequency output and synchronized acoustic and hydraulic pulses.

As a timing source and physical marker it acts as a reference frame.

As part of the observatory complex the TRANSMITTER acts as a fixed transit antenna to project electromagnetic energy into the plane of the ecliptic.

Radar targets generate reflections that are detected by the RECEIVER, and synchronized with the TRANSMITTER to make measurements regarding the size and structure of bodies and objects in the solar system.

The RECEIVER converts the reflected RF signal into acoustic, chemical, or cymatic data indicating the strength of the returned pulse.

By synchronizing the transmitted pulse with the received sig-

nal, distance and velocity to target can be calculated.

With sufficient technique, variables as rotation rate, rotation axis, and surface profiles could be calculated.

This radio astronomy system would provide unambiguous data regarding the astronomical unit, a fundamental constant in the size of the solar system.

Closer to home, it could serve as a terrestrial reference signal, self-calibrated and naturally powered.

Other uses are possible.

Chapter 11

SYNCHRONIZATION

Figure 11.1: OS OVERHEAD

11.1 TUNNELS

11.2 SHAFTS

11.3 BOXES

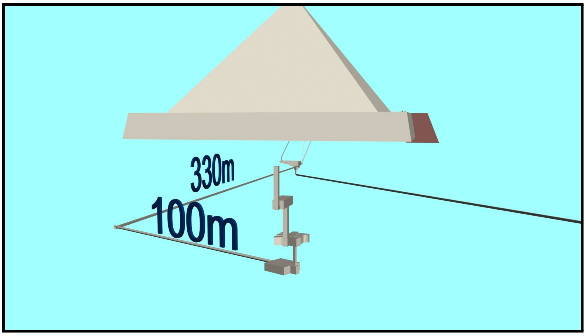


Figure 11.2: OS MEASURE

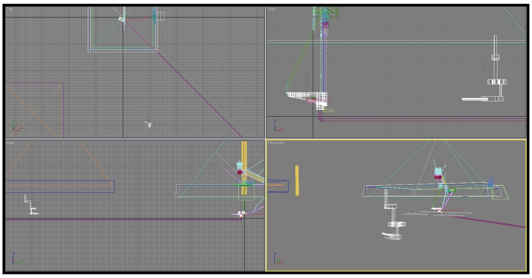


Figure 11.3: OS SCHEM

Chapter 12

ECHOES

Venus radar echo equations.

12.1 EQUATIONS

Received signal is reduced to the fourth power of transmitted signal by distance.

$$r = \sqrt[4]{\frac{(P_t)(A_0)(G_0)(\sigma)}{(P_r)(4\pi)^2}} \tag{12.1}$$

Transmission power:

$$P_t = 1MW\left(1 \times 10^6 W\right) \tag{12.2}$$

Amplification Gain

$$G_0 = 1000000\left(1 \times 10^6\right) \tag{12.3}$$

$$A_0 = (215m)(215m) = 46.2 \times 10^3 m^2 \tag{12.4}$$

$$P_r = \tilde{\ }1fW\left(1 \times 10^{-15} W\right) \tag{12.5}$$

$$r = \sqrt[4]{\frac{(1 \times 10^6 W)(46.2 \times 10^3 m^2)(1 \times 10^6)(3.721 \times 10^{12} m^2)}{(1 \times 10^{-15} W)(4\pi)^2}}$$

$$ \tag{12.6} $$

$$r = (5743.69)\sqrt[4]{\frac{(1 \times 10^6 W)(1 \times 10^6)}{(1 \times 10^{-15} W)}} \tag{12.7}$$

$$r = \sqrt[4]{1.09 \times 10^{42} m^4} \tag{12.8}$$

12.2 DISTANCE

The nearest approach distance of Venus is Earth-Sun Distance less Venus-Earth Distance.

$$r = Earth - SunDistance - Venus - SunDistance \tag{12.9}$$

$$r = 1.000 A.U - 0.723 A.U. \tag{12.10}$$

$$r = 0.277 A.U. \tag{12.11}$$

$$r = (0.277)\left(150 \times 10^9 m\right) \tag{12.12}$$

$$r = 41 \times 10^9 m \tag{12.13}$$

This is the minimum range for signal return from Venus.

$$t = \frac{r}{c} = \frac{41 \times 10^9 m}{3 \times 10^8 m/s} \tag{12.14}$$

$$t = 137 light - seconds \tag{12.15}$$

Twice that would be round-trip minimum echo delay, about four and one-half minutes.

12.3 ORRERY

The longer the contact the more prolonged the echo.

12.3.1 EARTH-VENUS

Referenced from the Great Pyramid, the Venus PYRAMID is located 481.0m away at a bearing of $224° \; 54'$. This is almost directly due south west.

12.3.2 DISTANCE

These reference distances and bearings are shown in Figure 12.1.

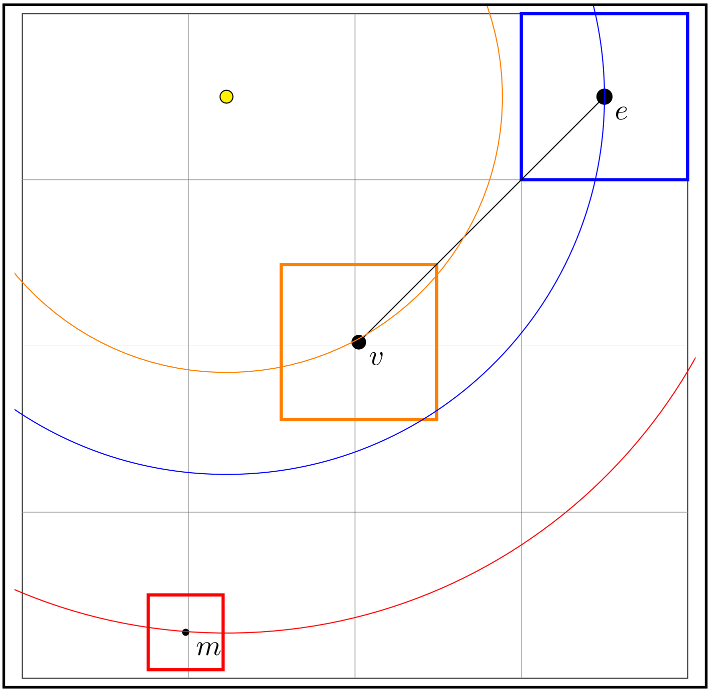


Figure 12.1: GRID
Grid with Reference Distances

12.4 MIN RANGE

Orrery range between Earth and Venus is 481 m in the map, therefore 481 ls.

$$R_{ORR} = 481ls = 481ls/(500ls/AU) = .96AU \tag{12.16}$$

$$P_{ORR} \propto R_{ORR}^4 \tag{12.17}$$

$$\frac{P_{ORR}}{P_{VEN}} \propto (\frac{R_{ORR}}{R_{VEN}})^4 \tag{12.18}$$

$$\frac{P_{ORR}}{P_{VEN}} \propto (\frac{(481)/(500)}{.21})^4 \tag{12.19}$$

$$P_{ORR} \approx 440 P_{VEN} \tag{12.20}$$

$$P_{MAX} \approx 440 \times P_{min} \approx 600 \times 10^6 W = 600 MW \tag{12.21}$$

If the observatory complex was able to return a signal from the planetary E-V configuration seen in the orrery layout - the Big Sky Map - then the power output of the SIGNAL would be orders of magnitude more efficient than these calculations detail.

Chapter 13

TARGETS

13.1 VENUS

13.1.1 ORBIT

0.723332 AU 108,208,000 km

13.1.2 RADIUS

6,051.8 1.0

13.1.3 SIGMA

The physical cross section (projected area) of Venus is given as

$$A_{venus} = \pi r_{venus}^2 \tag{13.1}$$

$$A_{venus} = \pi r_{venus}^2 \tag{13.2}$$

13.2 MOON

13.2.1 ORBIT

384399 km 0.00257 AU

13.2.2 RADIUS

1737.1 km

13.2.3 SIGMA

The physical cross section (projected area) of the moon is given as

$$A_{moon} = \pi r_{moon}^2 \tag{13.3}$$

$$A_{moon} = \pi r_{moon}^2 \tag{13.4}$$

13.2.4 EME

As a radar object the moon is

$$P_{EME} \approx \frac{41 \times 10^9 m}{363 \times 10^6} \tag{13.5}$$

113 times closer.

Since radar sensitivity goes by distance to the fourth power

$$(113)^4 \approx 1 \times 10^8 \tag{13.6}$$

13.3 MARS

13.3.1 ORBIT

SEMI-MAJOR AXIS

Semi-major axis of Mars

$$SMA_{mars} = 227939200km \tag{13.7}$$

$$SMA_{mars} = 1.523679AU \tag{13.8}$$

ECCENTRICITY

Eccentricity of Mars

$$ECC_{mercury} = 0.0934 \tag{13.9}$$

13.3.2 RADIUS

$$R_{mars} = 3389.5km \tag{13.10}$$

13.3.3 SIGMA

The physical cross section (projected area) of Venus is given as

$$A_{mars} = \pi r_{mars}^2 \tag{13.11}$$

$$A_{mars} = \pi(3389.5km)^2 \tag{13.12}$$

13.4 MERCURY

13.4.1 ORBIT

Semi-major axis of Mercury

$$SMA_{mercury} = 57,909,050km \tag{13.13}$$

$$SMA_{mercury} = 0.387098AU \tag{13.14}$$

ECCENTRICITY

Eccentricity of Mercury

$$ECC_{mercury} = 0.205630 \tag{13.15}$$

13.4.2 RADIUS

$$R_{mercury} = 2,439.71.0km \tag{13.16}$$

13.4.3 SIGMA

The physical cross section (projected area) of Venus is given as

$$A_{mercury} = \pi r_{mercury}^2 \tag{13.17}$$

$$A_{mercury} = \pi(2,440km)^2 \tag{13.18}$$

Part IV

APPENDICES

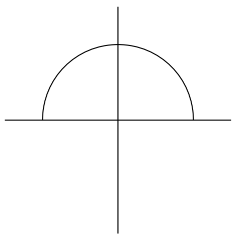
Chapter 14

UNITS

14.1 ANGLE

From a point, strike a line segment.

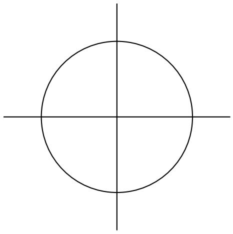
Rotate the segment around the point.



This is an *ANGLE*. Rotate the segment all the way around.

The rotating end traces a circle with the pivoting end at the center.

The length of the segment inside the circle is called the *RADIUS*.



The $DIAMETER$ equals twice the $RADIUS$.

$$DIAMETER = 2 * RADIUS \tag{14.1}$$

The distance around the circle is the $PERIMETER$.

The ratio of the $PERIMETER$ to the $DIAMETER$ is π.

$$PERIMETER = \pi * DIAMETER \tag{14.2}$$

also

$$PERIMETER = 2 * \pi * RADIUS \tag{14.3}$$

14.1.1 RADIAN

As a ray rotates to create a circle it subtends 2π identical angular parts called $RADIANS$.

Note that the angle of one-half circle rotation is $\pi RADIANS$.

Note that the angle of one-quarter circle rotation is $\frac{\pi}{4} RADIANS$.

14.1.2 DEGREE

A circle can also be divided into 360 identical angles called $DEGREES$ ($^\circ$).

Note that the angle of one-half circle rotation is $180 DEGREES$.

Note that the angle of one-quarter circle rotation is $90DEGREES$.

Note that $180DEGREES = \pi RADIANS$.

Note that $90DEGREES = \frac{\pi}{4}RADIANS$.

MINUTE

A $DEGREE$ is subdivided into 60 identical parts called $MINUTES$.

$$DEGREE = 60 * MINUTES \tag{14.4}$$

SECOND

A $MINUTE$ is subdivided into 60 identical parts called $seconds$.

$$MINUTE = 60 * SECONDS \tag{14.5}$$

$$DEGREE = 60 * 60 = 3600 * SECONDS \tag{14.6}$$

14.1.3 SOLIDANGLE

A solid angle is known as a $STERADIAN$.

14.2 TIME

As measured by clocks, time comes in units characterized by a specific period.

14.2.1 SECOND

A $SECOND$ is the time it takes light to travel approximately $3 \times 10^8 m$.

14.2.2 TWOSEC

The $TWOSEC$ seems to be an important observatory unit.

$$1TWOSEC = 2SECONDS \tag{14.7}$$

It may be merely a mathematical convenience, like $RADIUS$ to $DIAMETER$ or π degrees (half turn) to 2π degrees (full turn), but the system seems based on it.

See also the derivation of meter, in that a seconds pendulum is simple technology that links time and space.

14.2.3 MINUTE

One $MINUTE$ is defined as sixty $SECONDS$.

$$1MINUTE = 60SECONDS \tag{14.8}$$

14.2.4 HOUR

One $HOUR$ is defined as sixty $MINUTES$.

$$1HOUR = 60MINUTES = 3600SECONDS \tag{14.9}$$

14.2.5 DAY

One DAY is defined as twenty-four hours.

$$1DAY = 24HOURS \tag{14.10}$$

$$1DAY = 1440MINUTES \tag{14.11}$$

$$1DAY = 86400SECONDS \tag{14.12}$$

$$1DAY = 43200TWOSECS \tag{14.13}$$

A DAY becomes 43200 $TWOSECS$ by definition.

In astronomy the DAY as a fundamental unit of time normalizes the orbital period of the earth around the sun to the speed of its axial revolution.

These two terms contribute to its overall energy (see Appendix).

14.3 WAVES

Waves are forms that exist simultaneously in nature and mathematics that relate to repeating events in a medium.

14.3.1 CYCLE

Waves are used to express cycles and cyclic behavior.

14.3.2 PERIOD

$PERIOD$ is one complete cycle of a wave expressed in terms of time.

14.4 FREQUENCY

$FREQUENCY$ is the reciprocal of $PERIOD$.

14.4.1 WAVELENGTH

$WAVELENGTH$ is one complete cycle of a wave expressed in terms of length.

14.4.2 VELOCITY

$VELOCITY$ is the speed at which a wave moves.

14.4.3 EQUATION

These equations relate $VELOCITY$, $FREQUENCY$, and $WAVELENGTH$ for a wave.

$$VELOCITY = FREQUENCY \times WAVELENGTH \tag{14.14}$$

$$FREQUENCY = \frac{VELOCITY}{WAVELENGTH} \tag{14.15}$$

$$WAVELENGTH = \frac{VELOCITY}{FREQUENCY} \tag{14.16}$$

14.5 LENGTH

14.5.1 ANTHRPOCENTRIC

Anthropocentric units, as measured by direct senses and calibrated to our bodies.

INCH

An $INCH$ is approximately the width of a human thumb.

FOOT

An $INCH$ is also defined as one-twelfth part of a $FOOT$.

That is, a $FOOT$ is $12INCHES$.

$$1FOOT = 12INCHES \tag{14.17}$$

YARD

One $YARD$ is defined as three $FEET$.

$$1YARD = 3FEET \tag{14.18}$$

$$1YARD = 36INCHES \tag{14.19}$$

MILE

One $MILE$ is defined as 5280 $FEET$

$$1MILE = 5280FEET \tag{14.20}$$

14.5.2 GEOCENTRIC

Geocentric units, as measured by manufactured technology and calibrated to our planet.

METER

The $METER$ is typically defined as 1/10,000,000 part of a quarter perimeter of the Earth.

The $METER$ can also be defined in terms of the second pendulum, that length of a pendulum required to produce a two second cycle.

MILLIMETER

The $MILLIMETER$ is one-thousandth part of a $METER$.

CENTIMETER

The $CENTIMETER$ is one-hundredth part of a $METER$.

CENTIMETER

KILOMETER

A $KILOMETER$ is defined as one thousand $METERS$.

KNOT

A $KNOT$ is a nautical mile, defined as one angular minute of a meridian of the Earth.

$$1KNOT = \frac{2\pi R_{earth}}{360 * 60} \tag{14.21}$$

$$1KNOT = \frac{2(\pi)(6371km)}{360 * 60} \tag{14.22}$$

$$1KNOT = 1852m \tag{14.23}$$

14.5.3 BUILDER

CUBIT

the $CUBIT$ is a geocentric unit used by the builders.

DIGIT

One *CUBIT* contains twenty-eight *DIGIT*.

 DIGIT

 CENTIMETER

DIGIT = 0.0187 m = 1.87 cm = 18.7 mm

DIGIT = 0.7362 inch

PALM

One *PALM* equals four *DIGITS*

 CENTIMETER

PALM = 4 x 0.0187 m = 0.0748 m = 7.48 cm = 74.8 mm

PALM = 2.945 inch

One *CUBIT* equals seven *PALMS*.

$$1CUBIT = 7PALMS = 28DIGITS \tag{14.24}$$

Figure 14.1: 3D PRINTED CUBIT

DIAMETER (blue) equals one $METER$.

RADIUS (green) equals one-half $METER$.

CIRCUMFERENCE (red) equals six $CUBITS$.

$$CIRCUMFERENCE = \pi * DIAMETER \tag{14.25}$$

$$6CUBITS = \pi * 1m \tag{14.26}$$

$$1CUBIT = \frac{\pi}{6}m = \frac{100\pi}{6}cm = \frac{1000\pi}{6}mm \tag{14.27}$$

14.5.4 SOLAR

Geocentric units, as measured by light and radio technology and calibrated to our solar system.

ASTRONOMICALUNIT

One Astronomical Unit (1 A.U.) is equal to 149 597 871 kilometers.

This represents an average distance from the earth to the sun.

The earth does not travel in a perfectly circular orbit.

WHAT UNIT IS TO THE ROYAL CUBIT AS THE METER IS TO THE A.U. ?

LIGHTSECOND

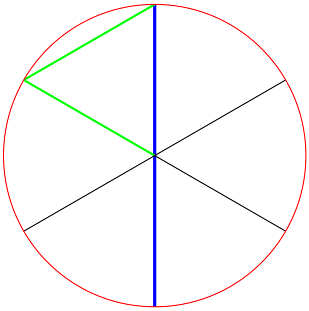
Another definition of unit TIME WOULD BE in terms of the time required for light to travels a given distance.

LIGHTYEAR

Unit length defined as the distance light travels in one unit $YEAR$.

14.5.5 CUBIT AND METER RELATION

CUBIT = 28 x 18.7 mm = 7 x 74.8 mm = 523.6 mm



14.5.6 INCH AND LIGHTYEAR

Miscellany - Inch and the Light-Year Assertion: the inch is to the mile, as the A.U. is to the L.Y.

$$\frac{Light - Year}{Astronomical\ Unit} \approx \frac{mile}{inch} \tag{14.28}$$

That is, does

$$\frac{\left(299.79 \times 10^6 m/sec\right)\left(365.2479 days\right)\left(86400 sec/day\right)}{149.6 \times 10^9 m} \tag{14.29}$$

approximate

$$5280 ft./mile * 12 inch/ft? \tag{14.30}$$

That is a factor of 63360.

$$\frac{365.25}{500} \approx \frac{5280 * 12}{60 * 60 * 24} \tag{14.31}$$

$$\frac{365.25}{500} \approx \frac{44}{60} \tag{14.32}$$

$$0.731 \approx 0.733 \tag{14.33}$$

This serves as an approximation.

14.5.7 METER CUBIT FOOT

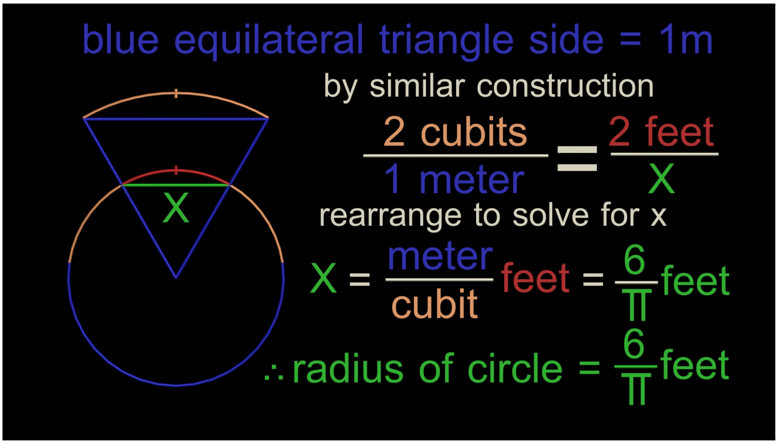


Figure 14.2: METER CUBIT FOOT

14.6 PLANET ENERGY

14.6.1 ROTATION

14.6.2 REVOLUTION

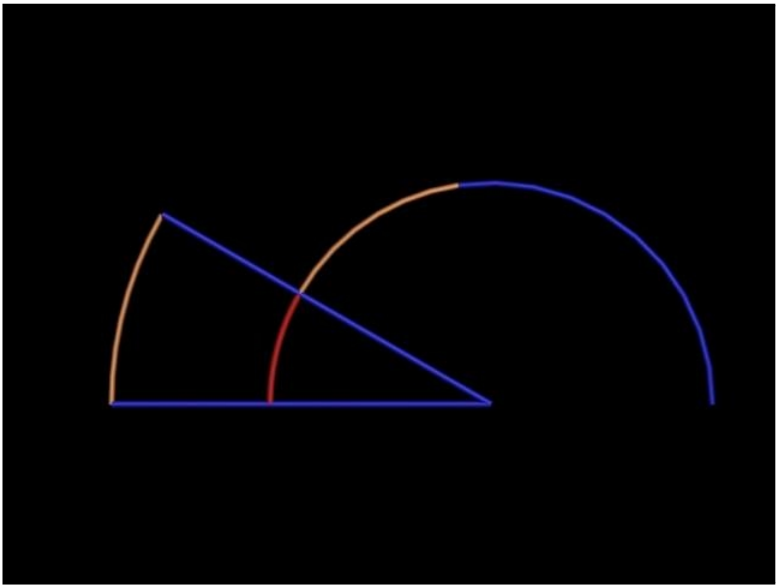


Figure 14.3: METER CUBIT FOOT blue=meter yellow=cubit red=foot

Chapter 15

VARIABLES

These tables list technical variables.

15.1 METRIC

This table lists technical variables in metric.

Table 15.1: Summary of Variables, VARIABLES

Symbol	Value	Units	Page	Definition
H_{xmtr}	146.6	m	32	TRANSMITTER height
B_{xmtr}	230.4	m	32	TRANSMITTER base
P_{xmtr}	921.2	m	32	TRANSMITTER perimeter (4xB_{xmtr})
M_{xmtr}	6.02×10^9	kg	39	TRANSMITTER mass (dry)
Q_{imp}	10×10^3	m^3/s	53	IMPULSE input flow rate
H_{moat}	22	m	36	MOATWALL height
V_{moat}	20000	m^3	45	MOAT capacity
H_{imp}	52.36	m	45	MOAT head
A_{imp}	1.25	m^2	47	IMPULSE area
L_{imp}	104.72	m	47	IMPULSE length
V_{imp}	131.25	m^3	47	IMPULSE volume
M_{imp}	131.25×10^3	kg	48	IMPULSE mass rho h2o 1kg/m^3
U_{imp}	67.35×10^6	J	48	IMPULSE potential energy into system
P_{imp}	33.68×10^6	W	50	IMPULSE max power theoretically
V_{max}	32.0	m/s	49	IMPULSE max velocity
$V_{closure}$	7.4	m/s	55	IMPULSE VALVE closure velocity

Continued on next page

Table 15.1 – continued from previous page

Symbol	Value	Units	Page	Definition
ΔP_p	9.6×10^6	Pa	58	IMPULSE pressure
M_{reg}	20×10^3	kg	66	REGULATOR three-stone mass
V_{ref}	144	m^3	68	capacity reference
V_{total}	1004.83	m^3	69	capacity upper chambers
V_{pulsed}	10	m^3	65	REGULATOR injection maximum
T_{fill}	200	s	70	fill time
W_{cycle}	40×10^6	J	73	cycle work
P_{cycle}	20×10^6	W	73	cycle power
E_{boil}	75×10^9	J	73	boil energy
T_{boil}	16×10^3	s	73	boil time
E_{xmtr}	0.17	n/a	75	REGULATOR efficiency
a	1500	m/s	60	IMPULSE sonic speed
$P_{reaction}$	1.5×10^9	W	94	reaction power
P_{radio}	150×10^6	W	94	radio frequency power
f_μ	1.420×10^6	Hz	108	microwave signal output frequency
P_min	1.5×10^6	W	107	microwave signal output power (minimum)
P_{max}	600×10^6	W	136	microwave signal output power (max. est.)
R	.96	A.U.	135	microwave signal range

15.2 UNITS OF THE BUILDERS

This table lists relevant values in the units of the builders.

Table 15.2: Builder Values, VALUES

Symbol	**Value**	**Units**	**Page**	**Definition**
π	3.14159…	n/a	const	ratio circle circumference to diameter
ϕ	1.618…	n/a	const	golden ratio
e	2.7183…	n/a	const	base of natural logarithm
c	572,561,420	cubits/sec	const	speed of light
$A.U.$	285.7×10^9	cubits	const	Astronomical Unit
R_{earth}	12.2×10^6	cubits	??	Earth radius
g	18.7	cubits/s^2	const	acceleration of gravity
H_{xmtr}	280	cubits	32	TRANSMITTER height
B_{xmtr}	440	cubits	32	TRANSMITTER base
P_{xmtr}	1760	m	32	TRANSMITTER perimeter (4xB_{xmtr})
H_{imp}	16	palms	47	IMPULSE height
W_{imp}	14	palms	47	IMPULSE width
L_{RC}	20	cubits	97	RESONANCE CHAMBER length
W_{RC}	10	cubits	97	RESONANCE CHAMBER width

Chapter 16

ORRERY

Our Solar System in the Layout at Giza

16.1 Purpose

This paper demonstrates a procedure for checking coincidence of arbitrary points with planetary orbits, followed by an application to the layout of the great pyramids at Giza.

16.2 Procedure

The steps used to implement the procedure are as follows:

16.2.1 Overview

- Develop equations regarding generalized points representing orbital centers
- Develop normalized model and equations for scaling
- Examine Giza topography and develop model and grid
- Determine circle of suitable orbital centers for Earth and Venus

- Determine circles of suitable orbital centers for Earth and Mercury
- Determine circles of suitable orbital centers for Earth and Mars
- Check intersection of circles to check coincidence with mutual orbits

16.2.2 Two Points

Consider two points e and v separated by a distance V. For convenience place point e at the origin and point v at a distance V along the x-axis as shown in Figure 16.1.

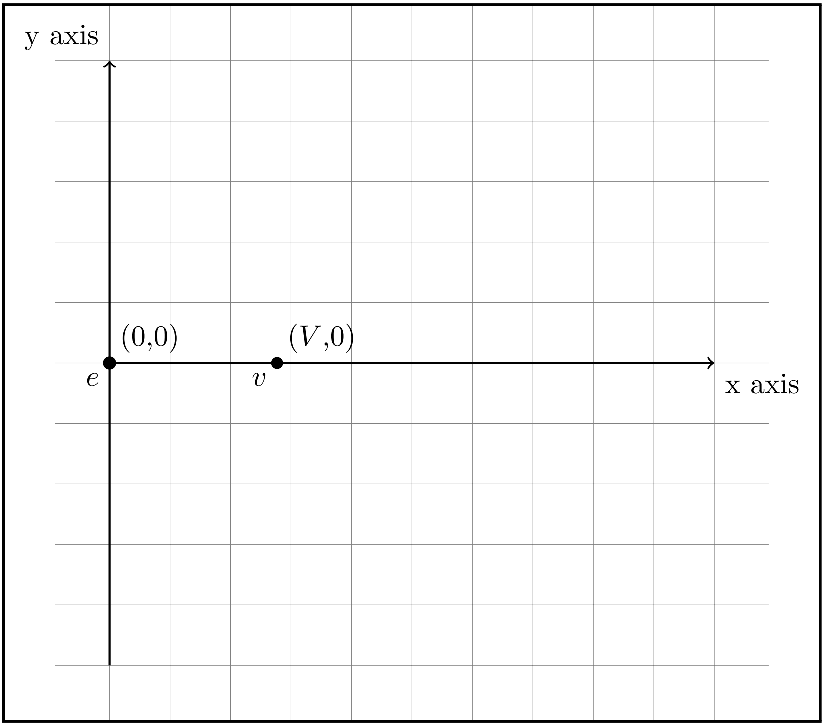


Figure 16.1: TWO POINTS
Two Points

16.2.3 Two Points and a Third Point

Next consider a third point s anywhere on the grid as shown in Figure 16.2. s is distance r_e from e, and distance r_v from v.

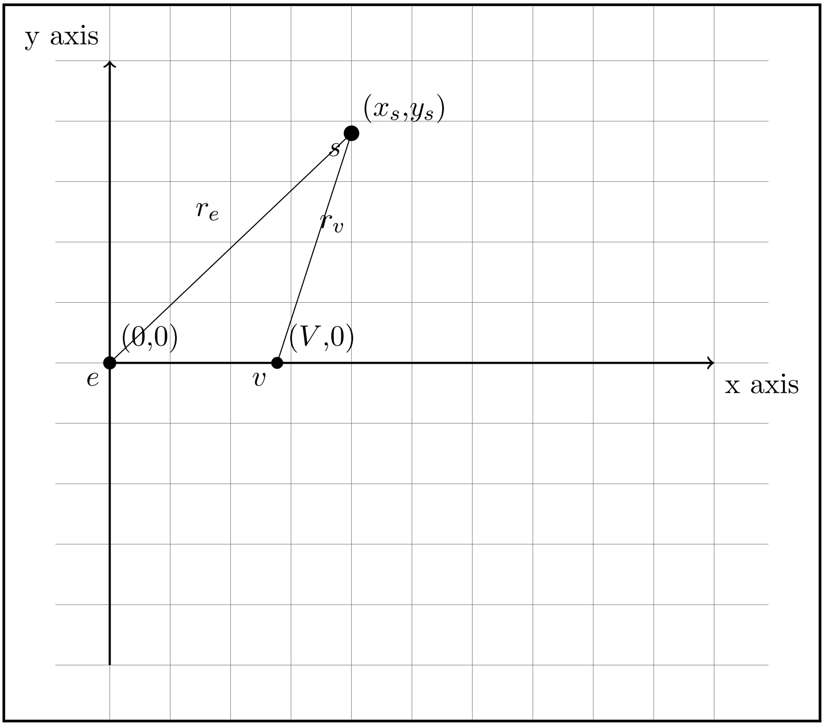


Figure 16.2: TWO POINTS AND A THIRD POINT

Two Points and a Third Point

Figure 16.3 interprets r_e and r_v as the radii of two circles with e and v on their respective circumferences and s at their centers.

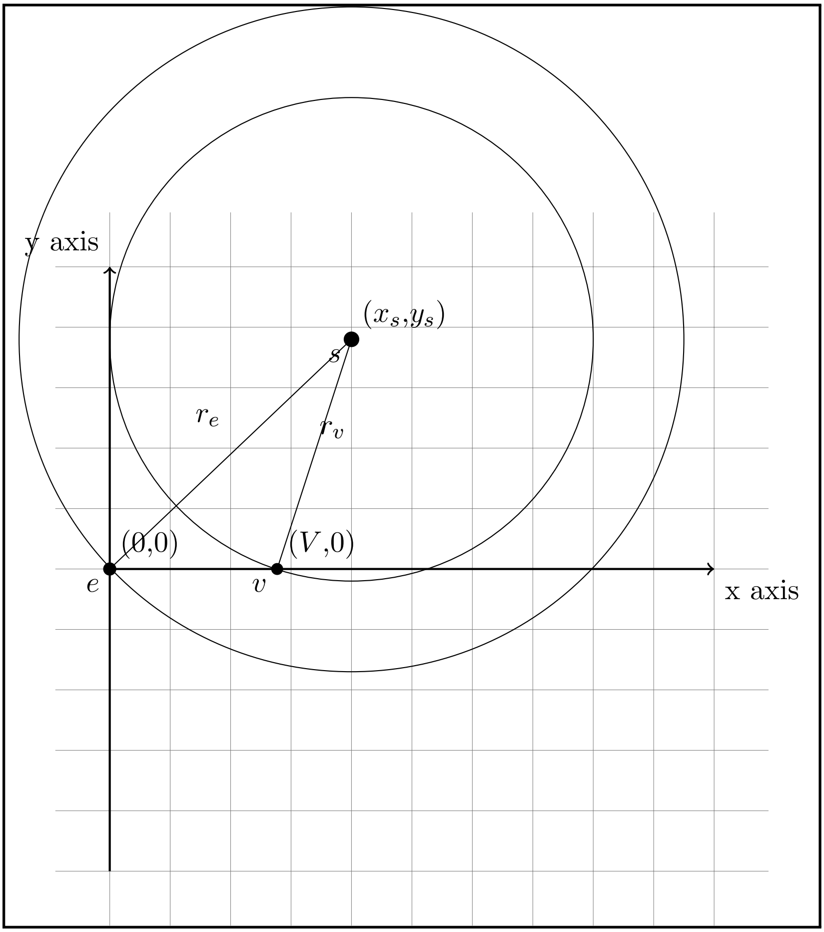


Figure 16.3: TWO POINTS ORBITING A THIRD POINT

Two Points Orbiting a Third Point

16.2.4 Euclidean Distances

The Euclidean distances r_e and r_v can be calculated using the Cartesian coordinates of the points.

$$r_e^2 = (x_s - x_e)^2 + (y_s - y_e)^2 \tag{16.1}$$

$$r_v^2 = (x_s - x_v)^2 + (y_s - y_v)^2 \tag{16.2}$$

Since e is at the origin, $x_e = y_e = 0$.
Since v is on the x-axis, $x_v =$V and $y_v = 0$.
The distance equations simplify to:

$$r_e^2 = x_s^2 + y_s^2 \tag{16.3}$$

$$r_v^2 = (x_s - V)^2 + y_s^2 \tag{16.4}$$

Define k as the fraction of these lengths:

$$k = \frac{r_v}{r_e} \tag{16.5}$$

That is, k is the ratio of the shorter length to the longer length.

16.2.5 Distance Equations

The distance equations equate a proportional length of r_e to r_v.

$$kr_e = r_v \tag{16.6}$$

$$k\sqrt{x_s^2 + x_s^2} = \sqrt{(x_s - V)^2 + y_s^2} \tag{16.7}$$

$$k^2(x_s^2 + y_s^2) = (x_s - V)^2 + y_s^2 \tag{16.8}$$

$$k^2x_s^2 + k^2y_s^2 = (x_s - V)^2 + y_s^2 \tag{16.9}$$

$$k^2y_s^2 = -k^2x_s^2 + (x_s - V)^2 + y_s^2 \tag{16.10}$$

$$k^2y_s^2 - y_s^2 = -k^2x_s^2 + (x_s - V)^2 \tag{16.11}$$

$$(k^2 - 1)y_s^2 = -k^2x_s^2 + (x_s - V)^2 \tag{16.12}$$

$$(k^2 - 1)y_s^2 = -k^2x_s^2 + x_s^2 - 2Vx_s + V^2 \tag{16.13}$$

$$(k^2-1)y_s^2 = -(k^2-1)x_s^2 - 2Vx_s + V^2 \tag{16.14}$$

$$-(1-k^2)y_s^2 = +(1-k^2)x_s^2 - 2Vx_s + V^2 \tag{16.15}$$

$$(1-k^2)y_s^2 = -(1-k^2)x_s^2 + 2Vx_s - V^2 \tag{16.16}$$

$$y_s^2 = -x_s^2 + \frac{2V}{(1-k^2)}x_s - \frac{V^2}{(1-k^2)} \tag{16.17}$$

$$x_s^2 + y_s^2 = \frac{2V}{(1-k^2)}x_s - \frac{V^2}{(1-k^2)} \tag{16.18}$$

$$x_s^2 + y_s^2 = (\frac{2V}{(1-k^2)})(x_s - \frac{V}{2}) \tag{16.19}$$

16.2.6 Apollonian Circles

Typically a circle is defined as a set of points at a constant distance (the radius r) from another point (the center c). A circle can also be defined as a set of points that represent a constant ratio between two fixed points. Such a circle is referred to as an Apollonian Circle. The Apollonian Circle for points e and v with ratio k is shown in Figure 4.

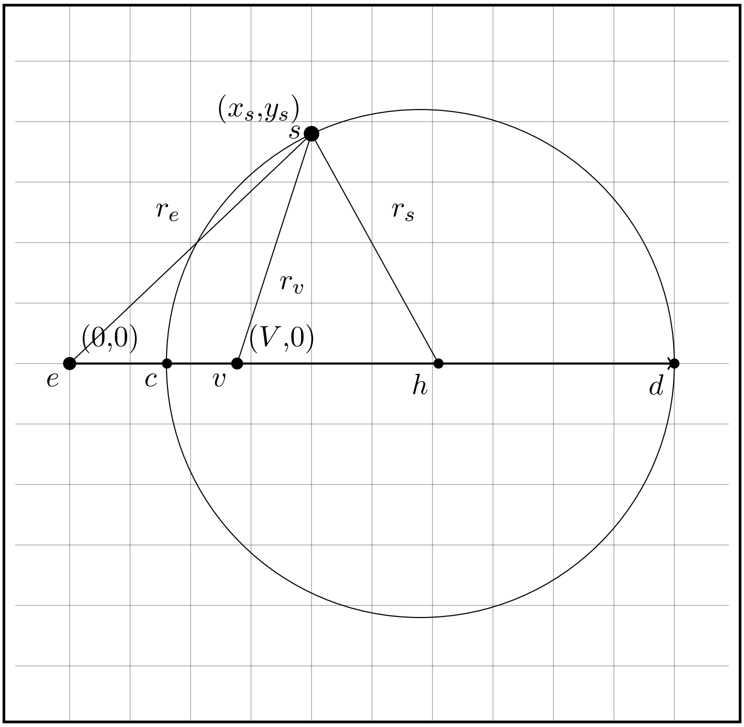


Figure 16.4: APOLLONIAN CIRCLE VARIABLES

Apollonian Circle Variables

Apollonian Circle Variables

Consider the two points on this circle that intersect the x-axis ($y_s = 0$). These are points c and d. Point h is defined as exactly half-way between them.

Maximum Intercept - x_d

Point d at $x_d = (D, 0)$ represents the maximum value for r_e and r_v.

$$V = D * (1 - k) \tag{16.20}$$

where $k < 1$.

Normalized System

The system can be normalized by defining the largest magnitude in x as 1, that is set point x_d at (1,0) by scaling all values by D. After scaling:

$$k = 1 - V \tag{16.21}$$

$$k^2(x_s^2 + y_s^2) = (x_s - (1 - k))^2 + y_s^2 \tag{16.22}$$

Minimum Intercept - x_c

Consider the point on the x-axis at which these conditions are true at x_c. This point represents the minimum value for r_e and r_v. At this point c ($y_c = 0$):

$$\frac{V - x_c}{x_c} = k \tag{16.23}$$

$$k = \frac{V - x_c}{x_c} \tag{16.24}$$

$$k = \frac{(1 - k) - x_c}{x_c} \tag{16.25}$$

$$kx_c = (1 - k) - x_c \tag{16.26}$$

$$kx_c + x_c = (1 - k) \tag{16.27}$$

$$(k + 1)x_c = (1 - k) \tag{16.28}$$

$$x_c = \frac{(1 - k)}{(1 + k)} \tag{16.29}$$

Subtracting the two values gives the diameter of the circle, twice the radius.

$$r_s = \frac{1 - x_c}{2} \tag{16.30}$$

Center of Apollonian Circle - x_h

The center, point h, is at the maximum value subtracting the radius, or the lower value adding it.

$$x_h = \frac{1}{2}(x_d + x_c) \tag{16.31}$$

$$x_h = \frac{1}{2}(1 + \frac{(1 - k)}{(1 + k)}) \tag{16.32}$$

$$x_h = \frac{1}{2}(\frac{(1 + k + 1 - k)}{(1 + k)}) \tag{16.33}$$

$$x_h = \frac{1}{(1 + k)} \tag{16.34}$$

The midpoint can also be found using calculus when y-value changes slope in equation (17):

$$y^2 = -x^2 + \frac{2(1 - k)}{(1 - k^2)}x - \frac{(1 - k)^2}{(1 - k^2)} \tag{16.35}$$

Take derivative of both sides by dx:

$$2y\frac{dy}{dx} = -2x + \frac{2(1 - k)}{1 - k^2} \tag{16.36}$$

at x_h where $\frac{dy}{dx} = 0$, left side of equation is 0.

$$2x_h = \frac{2(1 - k)}{1 - k^2} \tag{16.37}$$

$$x_h = \frac{1-k}{1-k^2} \tag{16.38}$$

Check against earlier value

$$\frac{1-k}{1-k^2} \stackrel{?}{=} \frac{1}{(1+k)} \tag{16.39}$$

$$(1-k)(1+k) \stackrel{?}{=} 1-k^2 \tag{16.40}$$

$$1-k^2 \stackrel{!}{=} 1-k^2 \tag{16.41}$$

16.3 Planets

16.3.1 Kepler's Variables

Kepler's Laws characterize planetary orbits according to mathematical features. Among these features are the Semi-Major Axis (SMa) and the Eccentricity (Ecc) of each planet's orbit. To the first order an orbit can be represented by a circle, each world traveling a path of points at the same distance around the sun. This distance is the SMa and the extent to which the circle becomes increasingly elliptical is represented by the Ecc.

16.3.2 Solar System model

In the model points e and v represent two different planets with different SMa. Point s represents the sun, the orbital center of the planets. Points e and v are located on concentric circles around s with radii r_e and r_v as shown in Figure 16.3.

16.3.3 Our Solar System

The inner planets of our solar system can be modeled as a set of consistently scaled concentric circles with the sun at the origin. Orbital extremes are color coded blue for outer, red for inner, and green for SMa. This model is shown in Figure 16.5.

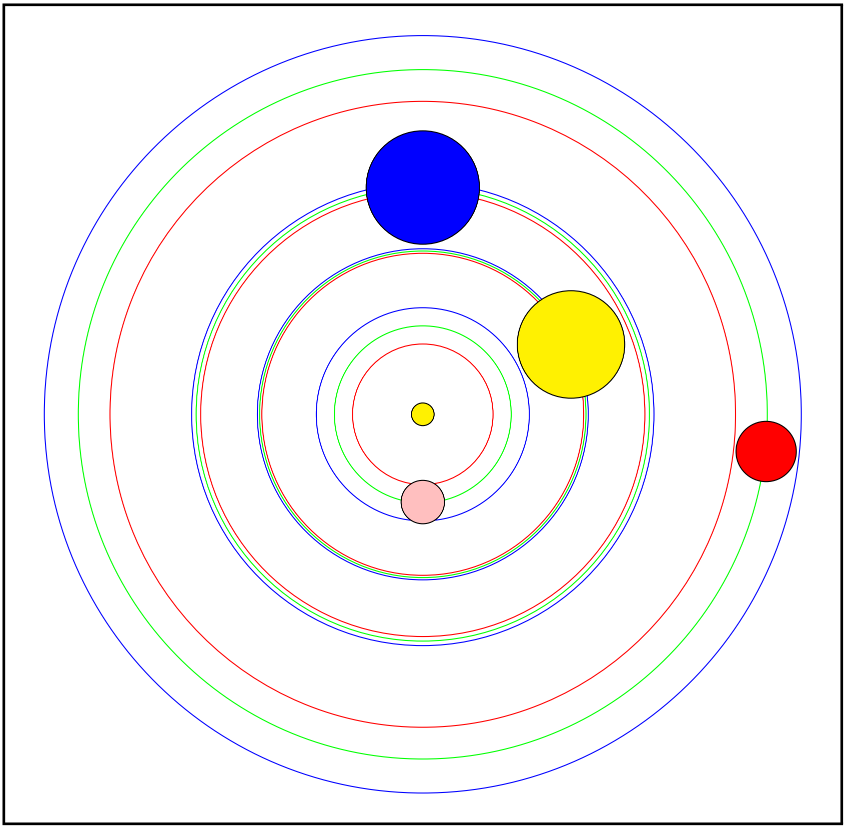


Figure 16.5: INNER SOLAR SYSTEM

Inner solar system. Scale of orbits does not equal scale of objects.

16.3.4 Astronomical Unit Scaling

In the normalized system, we can take advantage of solar system scaling using the Astronomical Unit (A.U.). The distance from Earth to the Sun is 1 A.U.

16.3.5 Calculating with the Normalized System

The normalized system is considered from the outer point at the origin point e. That is, the outermost planet is at point e and the innermost planet is at point v. The sun is at point s, at coordinates (1,0). Therefore when considering Earth and Venus or Earth and Mercury, Earth will be at the origin. When considering Earth and Mars, then Mars will be at the origin and Earth at point v. All results must be scaled and rescaled accordingly.

16.3.6 Apollonian Circles for Earth-Venus

Venus varies between 0.718 and 0.728 A.U. with $SMa = 0.723$.

SMa

Substituting $k = 0.723$ in equations (29), (30), and (34):

$$x_c = \frac{(1 - 0.723)}{(1 + 0.723)} = 0.161 \tag{16.42}$$

$$x_h = \frac{1}{1 + k} = \frac{1}{1.723} = 0.580 \tag{16.43}$$

$$r_s = \frac{1 - x_c}{2} = \frac{1 - 0.161}{2} = 0.420 \tag{16.44}$$

A circle with radius=0.420 located at (0.580,0) is shown in Figure 16.6

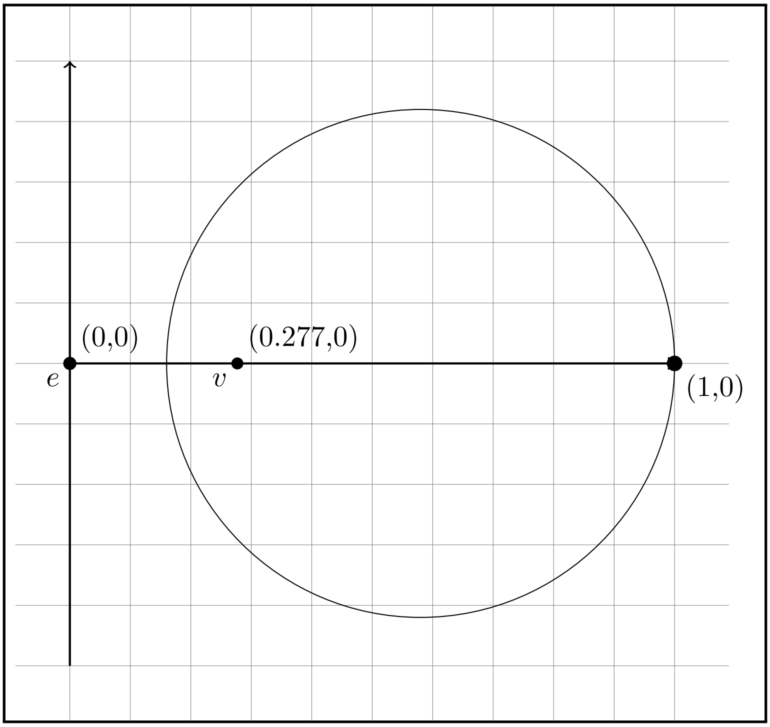


Figure 16.6: NORMALIZED APOLLONIAN CIRCLE FOR EARTH VENUS SMa

Normalized Apollonian Circle for Earth Venus SMa

Outer

$k = 0.728$

$$x_c = \frac{(1-0.728)}{(1+0.728)} = 0.157 \tag{16.45}$$

$$x_h = \frac{1}{1+k} = \frac{1}{1.723} = 0.579 \tag{16.46}$$

$$r_{ac} = \frac{1-x_c}{2} = \frac{1-0.157}{2} = 0.421 \tag{16.47}$$

A circle with radius=0.421 located at (0.579,0) is shown in Figure 16.7.

Inner

$k = 0.718$

$$x_c = \frac{(1-0.718)}{(1+0.718)} = 0.164 \tag{16.48}$$

$$x_h = \frac{1}{1+k} = \frac{1}{1.723} = 0.582 \tag{16.49}$$

$$r_s = \frac{1-x_c}{2} = \frac{1-0.164}{2} = 0.418 \tag{16.50}$$

A circle with radius=0.418 located at (0.582,0) is shown in Figure 7.

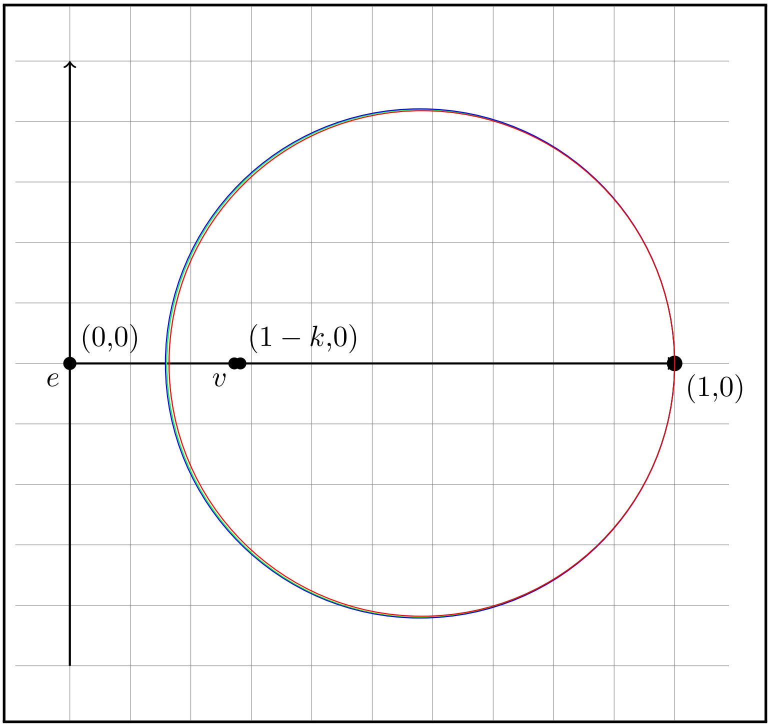


Figure 16.7: NORMALIZED APOLLONIAN CIRCLES EARTH VENUS OUTER INNER

Normalized Apollonian Circles Earth Venus Outer Inner

Due to the low eccentricity of Venus, for these purposes only the SMa Apollonian Circle will be used.

16.3.7 Apollonian Circles for Earth-Mercury

Mercury varies between 0.307 and 0.467 A.U. with $SMa = 0.387$.

SMa

$k = 0.387$

$$x_c = \frac{(1-0.387)}{(1+0.387)} = 0.442 \tag{16.51}$$

$$x_h = \frac{1}{1+k} = \frac{1}{1.387} = 0.721 \tag{16.52}$$

$$r_s = \frac{1-x_c}{2} = \frac{1-0.442}{2} = 0.279 \tag{16.53}$$

A circle with radius=0.279 located at (0.721,0) is shown in Figure 16.8.

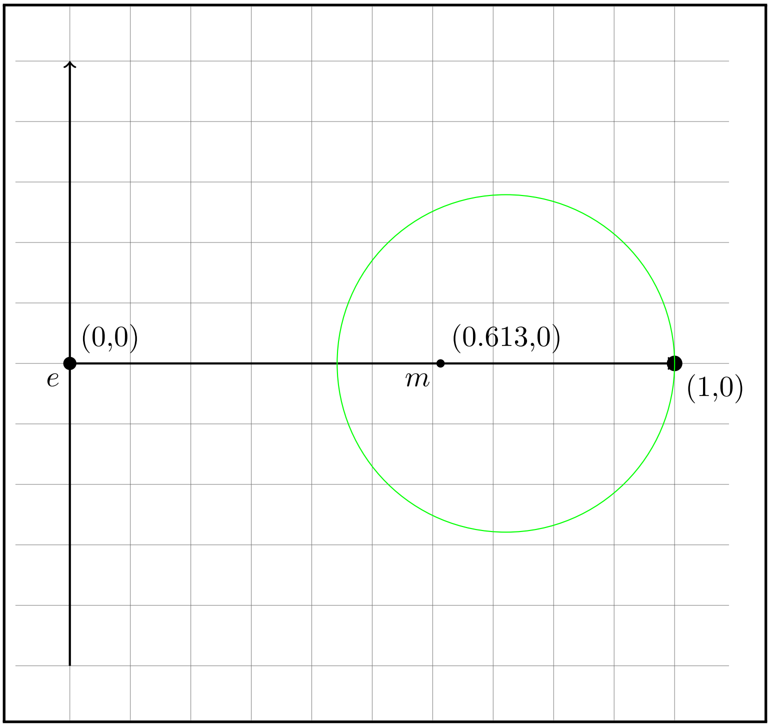


Figure 16.8: NORMALIZED APOLLONIAN CIRCLE EARTH MERCURY SMa

Normalized Apollonian Circle Earth Mercury SMa

Outer

$k = 0.467$

$$x_c = \frac{(1 - 0.467)}{(1 + 0.467)} = 0.363 \tag{16.54}$$

$$x_h = \frac{1}{1 + k} = \frac{1}{1.467} = 0.680 \tag{16.55}$$

$$r_s = \frac{1 - x_c}{2} = \frac{1 - 0.363}{2} = 0.318 \tag{16.56}$$

A circle with radius=0.318 located at (0.680,0) is shown in Figure 16.9.

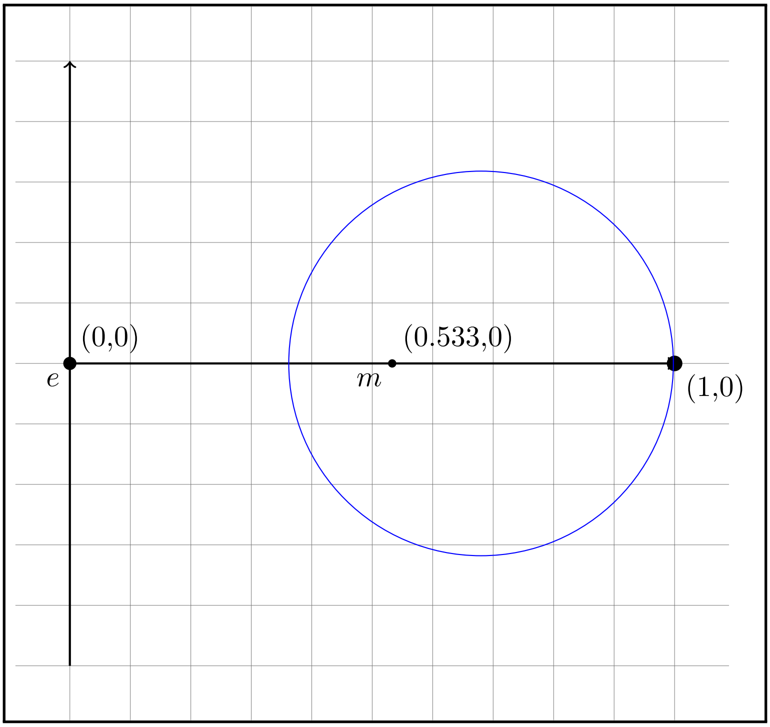


Figure 16.9: NORMALIZED APOLLONIAN CIRCLE EARTH MERCURY OUTER

Normalized Apollonian Circle Earth Mercury Outer

Inner

$k = 0.307$

$$x_c = \frac{(1 - 0.307)}{(1 + 0.307)} = 0.530 \tag{16.57}$$

$$x_h = \frac{1}{1 + k} = \frac{1}{1.307} = 0.765 \tag{16.58}$$

$$r_s = \frac{1 - x_c}{2} = \frac{1 - 0.530}{2} = 0.235 \tag{16.59}$$

A circle with radius=0.235 located at (0.765,0) is shown in Figure 16.10.

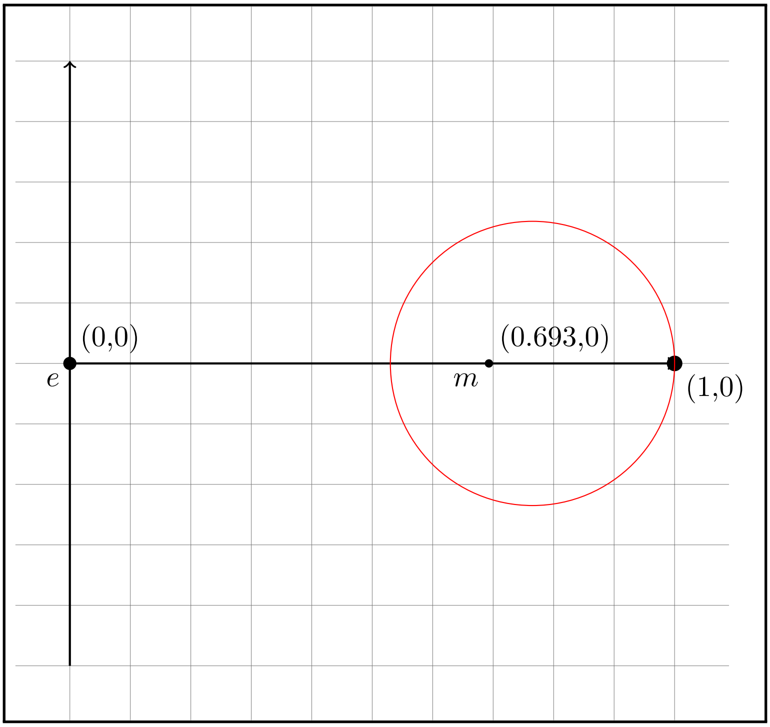


Figure 16.10: NORMALIZED APOLLONIAN CIRCLE EARTH MERCURY OUTER

Normalized Apollonian Circle Earth Mercury Outer

16.3.8 Apollonian Circles for Mars-Earth

Mars varies between 1.3814 and 1.6660 A.U. with $SMa =$ 1.5237.

SMa

For Mars-Earth in the normalized system,

$$k = \frac{(1)}{1.5237} = 0.6563 \tag{16.60}$$

$$x_c = \frac{(1 - 0.6563)}{(1 + 0.6563)} = 0.2075 \tag{16.61}$$

$$x_h = \frac{1}{1 + k} = \frac{1}{1.6563} = 0.6038 \tag{16.62}$$

$$r_s = \frac{1 - x_c}{2} = \frac{1 - 0.2075}{2} = 0.3962 \tag{16.63}$$

A circle with radius=0.3962 located at (0.6038,0) is shown in Figure 16.11.

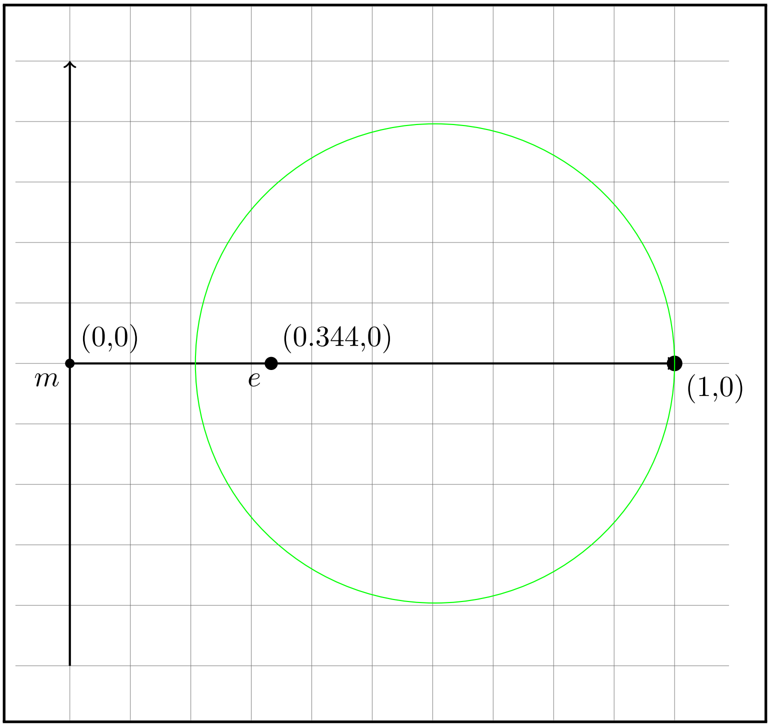


Figure 16.11: NORMALIZED APOLLONIAN CIRCLE MARS EARTH SMa

Normalized Apollonian Circle Mars Earth SMa

Outer

$$k = \frac{(1)}{1.6660}) = 0.6002 \tag{16.64}$$

$$x_c = \frac{(1-0.6002)}{(1+0.6002)} = 0.2498 \tag{16.65}$$

$$x_h = \frac{1}{1+k} = \frac{1}{1.6002} = 0.6249 \tag{16.66}$$

$$r_s = \frac{1-x_c}{2} = \frac{1-0.2498}{2} = 0.3751 \tag{16.67}$$

A circle with radius=0.3751 located at (0.6249,0) is shown in Figure 16.12.

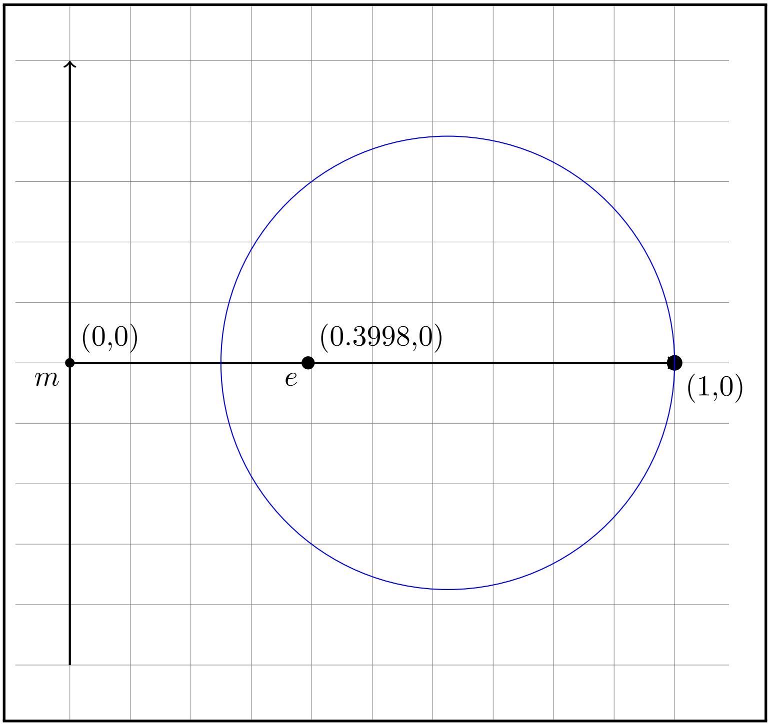


Figure 16.12
Normalized Apollonian Circle Mars Earth Outer

Inner

$$k = \frac{(1)}{1.3814} = 0.7239 \tag{16.68}$$

$$x_c = \frac{(1 - 0.7239)}{(1 + 0.7239)} = 0.1602 \tag{16.69}$$

$$x_h = \frac{1}{1 + k} = \frac{1}{1.7239} = 0.5801 \tag{16.70}$$

$$r_s = \frac{1 - x_c}{2} = \frac{1 - 0.1602}{2} = 0.4199 \tag{16.71}$$

A circle with radius=0.4199 located at (0.5801,0) is shown in Figure 16.13.

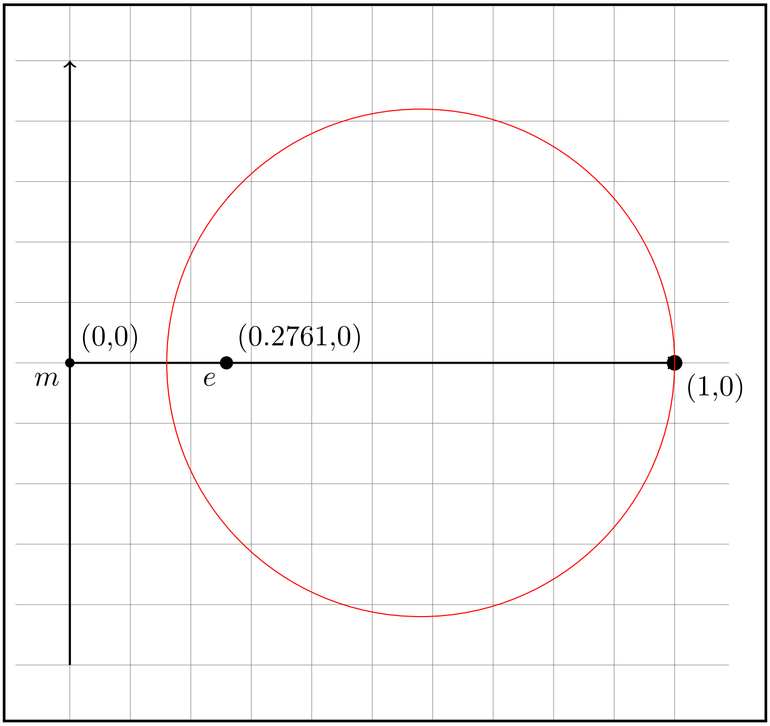


Figure 16.13
Normalized Apollonian Circle Mars Earth Inner

16.3.9 Applying the math

This normalized system can be rotated and uniformly scaled around the origin. Such operations can be used to scale and orient the results to the size of the Giza layout.

16.4 Pyramids

Global coordinates accessed from Wikipedia.

16.4.1 Earth Pyramid

$29^\circ\ 58'\ 45.03''$ N (+29.979175)
$31^\circ\ 8'\ 3.69''$ E (+31.134358)

16.4.2 Venus Pyramid

$29^\circ\ 58'\ 34''$ N (+29.976111)
$31^\circ\ 7'\ 51''$ E (+31.130833)

16.4.3 Mars/Mercury Pyramid

$29^\circ\ 58'\ 21''$ N (+29.9725)
$31^\circ\ 7'\ 42''$ E (+31.128333)

16.4.4 Royal Cubit

Conversion between meter and royal cubit (rc)

$$1rc = \frac{\pi}{6} meters \tag{16.72}$$

16.4.5 Grid

The grid is scaled by the Earth pyramid using its size as a reference unit (440rc×440rc). From that reference unit extends a four by four grid. Each side of this grid is $1760rc$ long. This grid is shown in Figure 16.14.

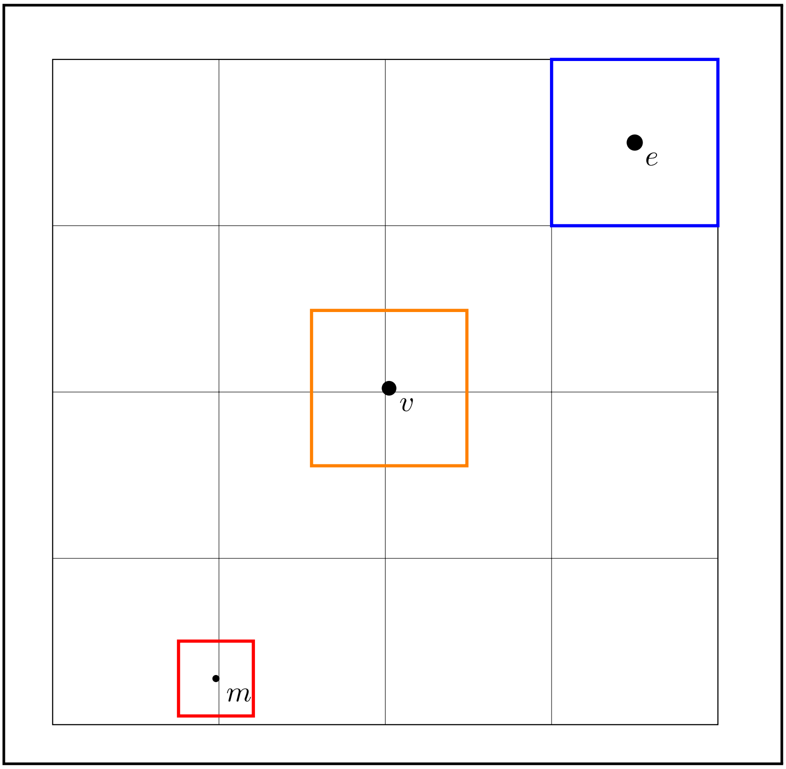


Figure 16.14
Grid with Pyramids

16.4.6 Haversine Formula

The Haversine Formula cam be used to compute the shortest distance over the Earths surface between two points. For this article an online calculator was applied to the coordinate data.

16.4.7 Earth Pyramid to Venus Pyramid

Referenced from the Great Pyramid, the Venus pyramid is located 481.0m away at a bearing of $224^\circ\ 54'$. This is almost directly due south west.

16.4.8 Earth Pyramid to Mercury/Mars Pyramid

Referenced from the Great Pyramid, the third pyramid is located 942.2m away at a bearing of $218^\circ\ 01'$.

16.4.9 Reference Distances

These reference distances and bearings are shown in Figure 16.15.

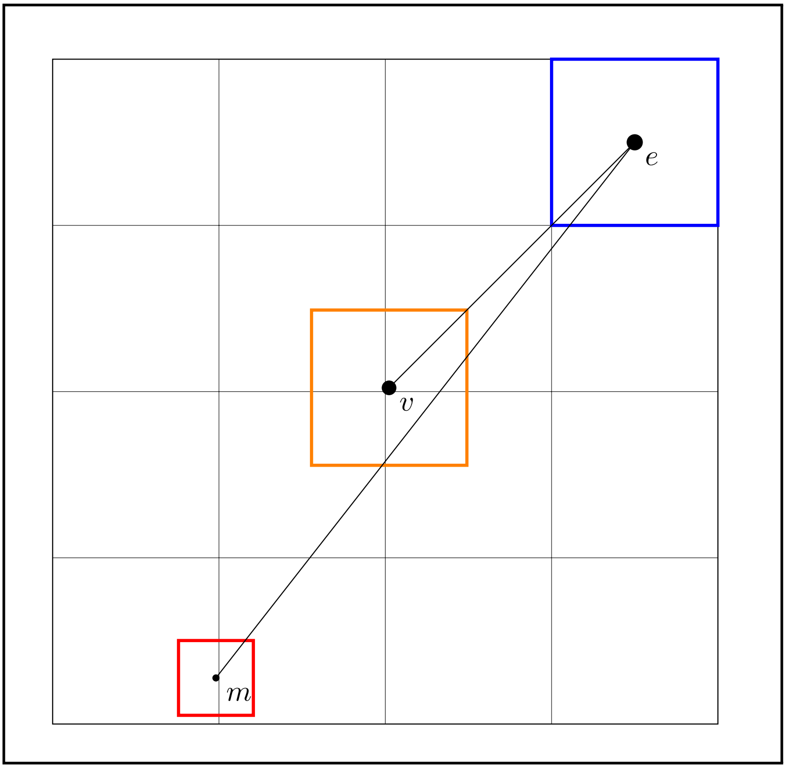


Figure 16.15
Grid with Reference Distances

16.5 Calculations

16.5.1 Overview

The basic element of the grid is scaled by the Earth pyramid. It is the reference point, the origin, for all calculations unless otherwise noted.

16.5.2 Scaling the Normalized Model

In order to translate these results from the normalized model to actual physical coordinates,

$$V = D(1 - k) \tag{16.73}$$

where V and D are actual physical distances.

16.5.3 Scaling Earth-Venus

For scaling Earth-Venus, the distance V on the ground between the larger pyramids is 481.0m and $k = 0.723$.

$$D = \frac{V}{1-k} = \frac{481.0}{1-0.723} = 1736m \tag{16.74}$$

Results calculated in section 3.5 should be scaled by this value.

$$x_c * D = 0.1608 * 1736m = 279.1m \tag{16.75}$$

$$x_h * D = 0.5804 * 1736m = 1008m \tag{16.76}$$

$$r_s = \frac{D - x_c * D}{2} = \frac{1736m - 279.1m}{2} = 728.5m \tag{16.77}$$

This circle (radius= $728.5m$) located 1008 meters southwest of the Great Pyramid is shown in Figure 16.16.

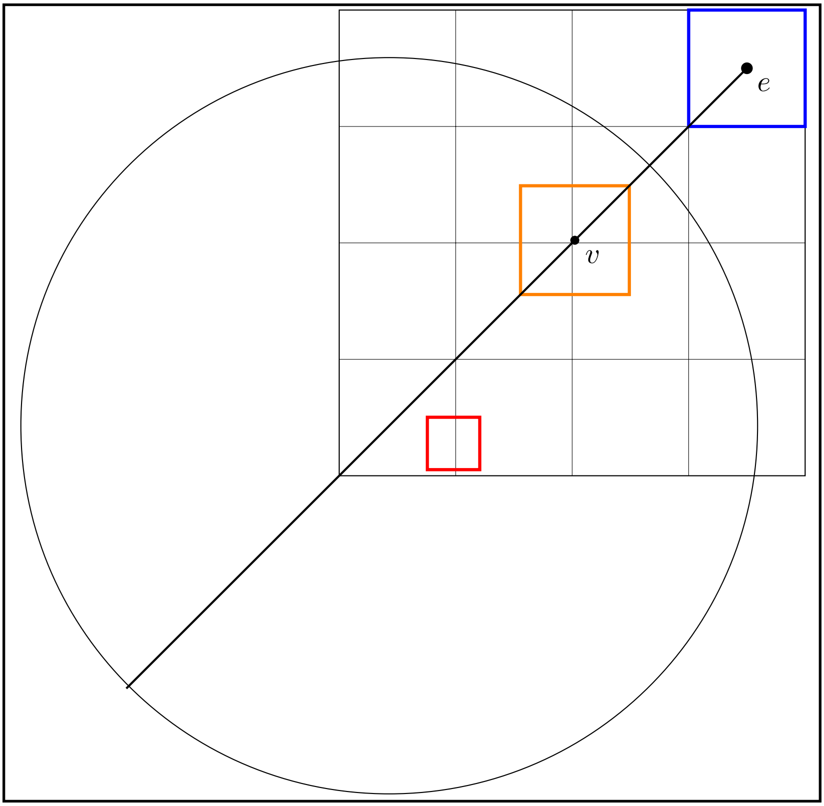


Figure 16.16
Apollonian Circle of Earth Venus

16.5.4 Scaling Earth-Mercury

The eccentricity of Mercury must be accounted for, generating three Apollonian Circles representing the average and extremes of its orbit. First the SMA (average) value is calculated then the outer (maximum) and inner (minimum) values.)) For Earth-Mercury, distance V on the ground between the largest and smallest pyramids is 942.2m.

Mercury SMa

$$k = 0.387 \tag{16.78}$$

$$D = \frac{V}{1-k} = \frac{942.2}{1-0.387} = 1537m \tag{16.79}$$

Results calculated in section 3.6 should be scaled by this value.

$$x_c * D = 0.442 * 1537m = 679m \tag{16.80}$$

$$x_h * D = 0.721 * 1537m = 1108m \tag{16.81}$$

$$r_s = \frac{1537m - 679m}{2} = 429m \tag{16.82}$$

Mercury Outer

$$k = 0.467 \tag{16.83}$$

$$D = \frac{V}{1-k} = \frac{942.2}{1-0.467} = 1768m \tag{16.84}$$

All values from the normalized Apollonian Circle should be scaled by this value for the outer case.

$$X_c = 0.363 * 1768m = 642m \tag{16.85}$$

$$X_h = 0.680 * 1768m = 1202m \tag{16.86}$$

$$r_{ac} = \frac{1768m - 642m}{2} = 563m \tag{16.87}$$

Mercury Inner

$$k = 0.307 \tag{16.88}$$

$$D = \frac{V}{1-k} = \frac{942.2}{1-0.307} = 1360m \tag{16.89}$$

All values from the normalized Apollonian Circle should be scaled by this value for the inner case.

$$x_c * D = 0.530 * 1360m = 720.8m \tag{16.90}$$

$$x_h * D = 0.765 * 1360m = 1040.4m \tag{16.91}$$

$$r_s = \frac{1360m - 720.8m}{2} = 319.6m \tag{16.92}$$

These three circles are shown in Figure 16.17.

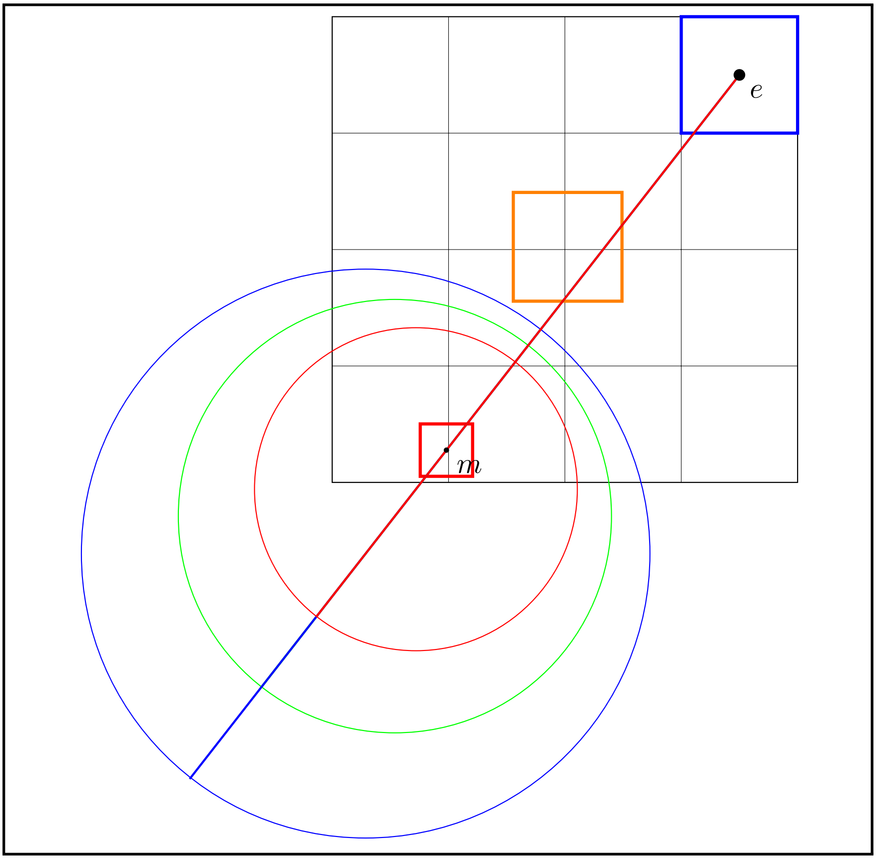


Figure 16.17
Apollonian Circles of Earth Mercury

16.5.5 Scaling Mars-Earth

As in the case with Mercury, three Apollonian Circles will be generated representing the extremes of the orbit of Mars. The distance V is again 942.2m.

Mars SMa

$k = .6563$

$$D = \frac{V}{1-k} = \frac{942.2}{1-0.6563} = 2741.34m \tag{16.93}$$

Results calculated in section 3.7 should be scaled by this value.

$$x_c * D = 0.2075 * 2741.34m = 568.828m \tag{16.94}$$

$$x_h * D = 0.6038 * 2741.34m = 1655.2211m \tag{16.95}$$

$$r_s = \frac{2741.34m - 568.828m}{2} = 1086.256m \tag{16.96}$$

Mars Outer

$$k = .6002 \tag{16.97}$$

$$D = \frac{V}{1-k} = \frac{942.2}{1-0.6002} = 2356.68m \tag{16.98}$$

All values from the normalized Apollonian Circle should be scaled by this value for the SMa case.

$$x_c * D = 0.2498 * 2356.68m = 588.698m \tag{16.99}$$

$$x_h * D = 0.6249 * 2356.68m = 1472.6893m \tag{16.100}$$

$$r_s = \frac{2356.68m - 588.698m}{2} = 883.99m \tag{16.101}$$

Mars Inner

$$k = .7239 \tag{16.102}$$

$$D = \frac{V}{1-k} = \frac{942.2}{1-0.7239} = 3412.532m \tag{16.103}$$

All values from the normalized Apollonian Circle should be scaled by this value for the SMa case.

$$x_c * D = 0.1602 * 3412.532m = 546.688m \tag{16.104}$$

$$x_h * D = 0.5801 * 3412.532m = 1979.6096m \tag{16.105}$$

$$r_s = \frac{3412.532m - 546.688m}{2} = 1432.922m \tag{16.106}$$

These three circles are shown in Figure 16.18.

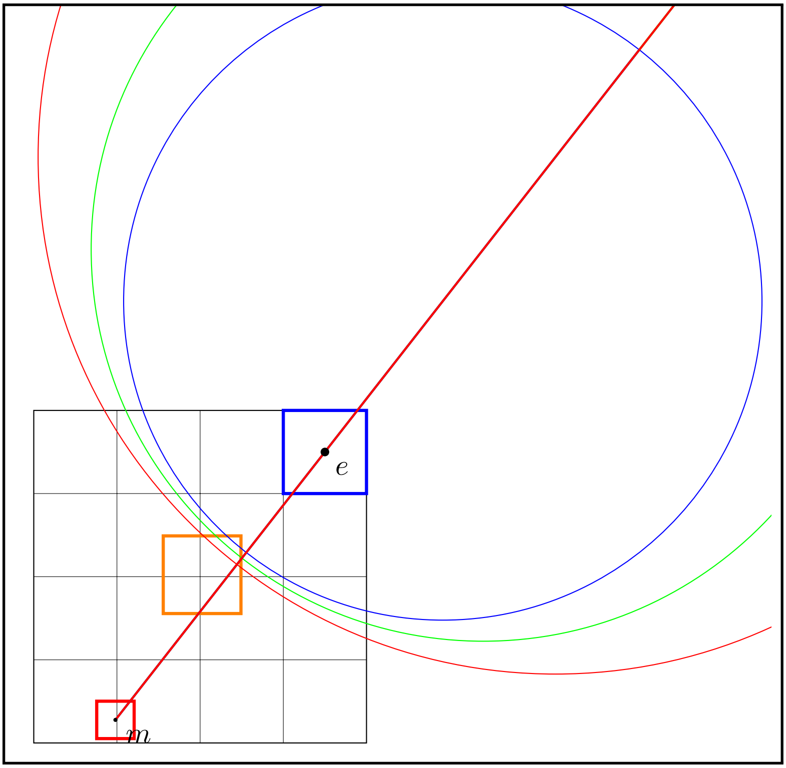


Figure 16.18

Apollonian Circle of Mars Earth

16.6 Analysis

16.6.1 Intersecting Circles

This procedure uses scale invariance, that is all bodies are scaled the same relative to each other. Knowing in general if:

A is to B
A is to C
then B is to C

then specifically regarding the orbital ratios of SMa values found in this problem:

E is to V
E is to M
then V is to M

By constructing mutual Apollonian Circles at the same scale, planetary layouts will be sensible only at intersection points between these Circles. If any point on the Apollonian Circle representing Earth-Venus also intersects the Apollonian Circle representing Mercury or Mars, then at that point the value of k for both Circles is the same. The model is to scale at that point.

16.6.2 Earth Venus Mercury

Figure 16.19 shows the Apollonian Circles of Earth-Venus (Figure 16.16) and Earth-Mercury (Figure 16.17). Of the three Earth-Mercury circles only the outer intersects the Apollonian Circle of Earth-Venus. The model of the solar system does not hold at SMa or the inner extreme of Mercury's orbit since there is no intersection.

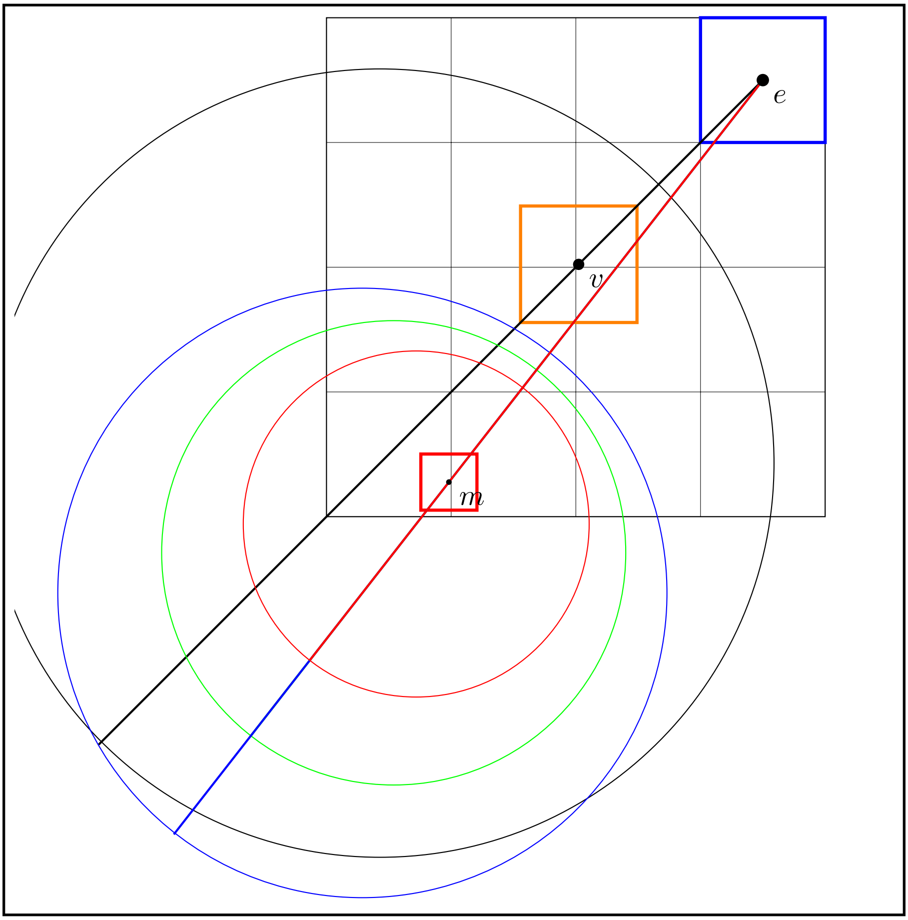


Figure 16.19
Apollonian Circle of Earth Venus Mercury

16.6.3 Earth Venus Mars

Figure 16.20 shows the Apollonian Circles of Earth-Venus (Figure 16.16) and Mars-Earth (Figure 16.18). All three Mars-Earth circles intersect the Apollonian Circle of Earth-Venus. That is, the model of the solar system holds at SMa and either extreme of Mars orbit.

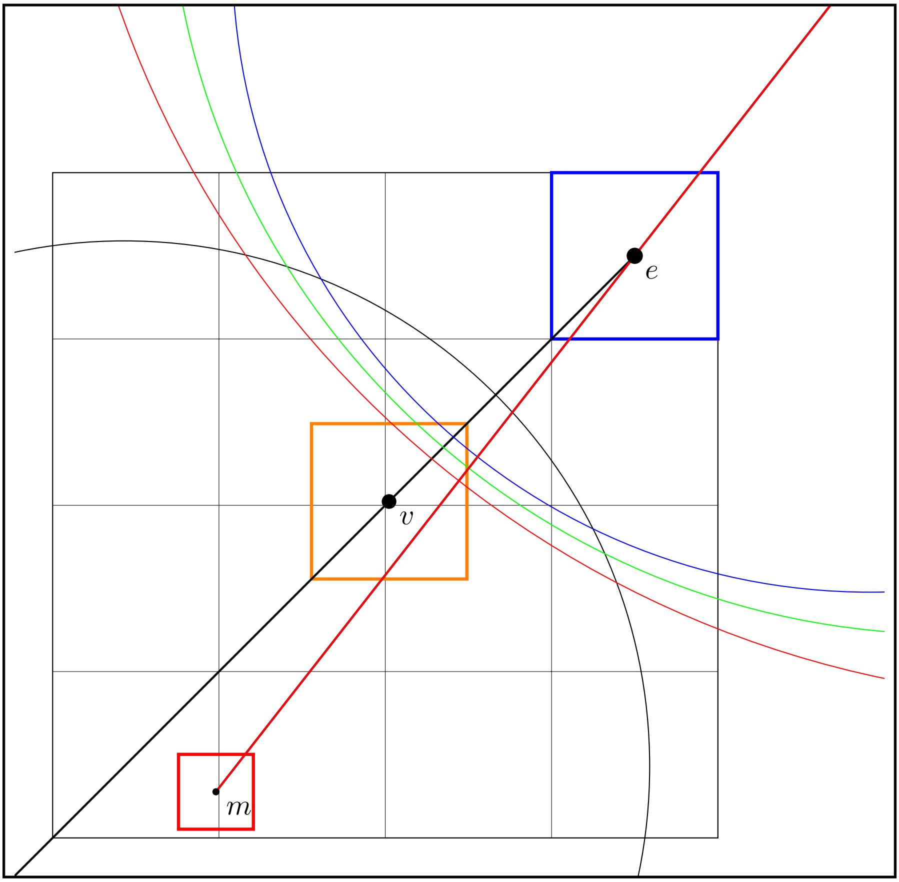


Figure 16.20
Apollonian Circles of Earth Venus Mars

16.7 Conclusions

Mathematics of proportion cannot falsify a general model of the Giza plateau aligned to the inner planets in our solar system. Alignments involving Mercury are meaningless over considerable portions of its eccentric orbit. Alignments involving Mars are meaningful over its entire orbit.

Chapter 17

FIGURES

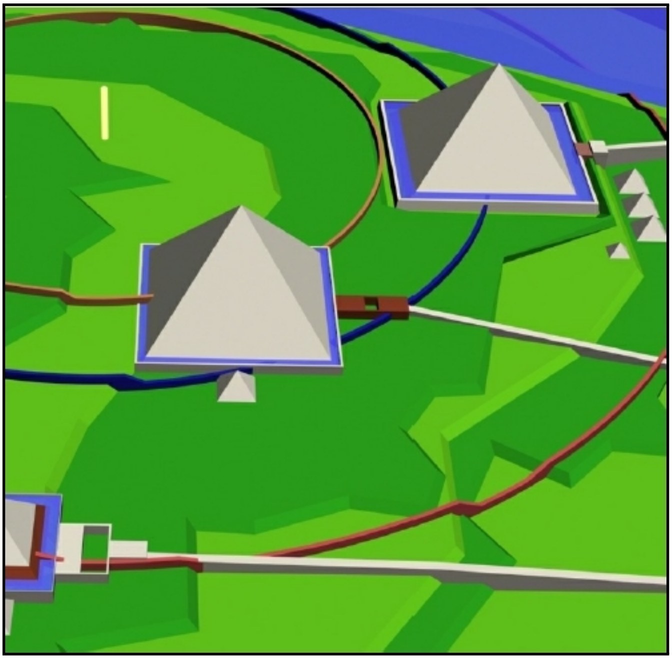


Figure 17.1: ORRERY VIEW

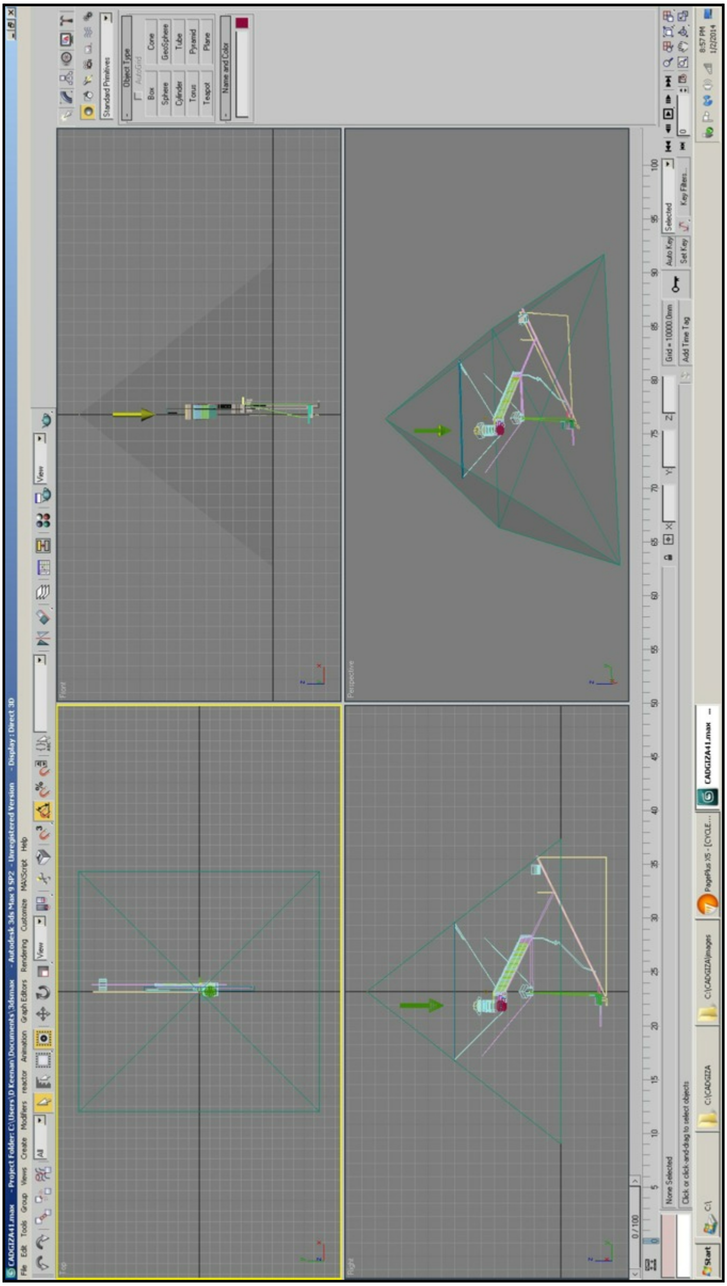


Figure 17.2: CROSS SECTION

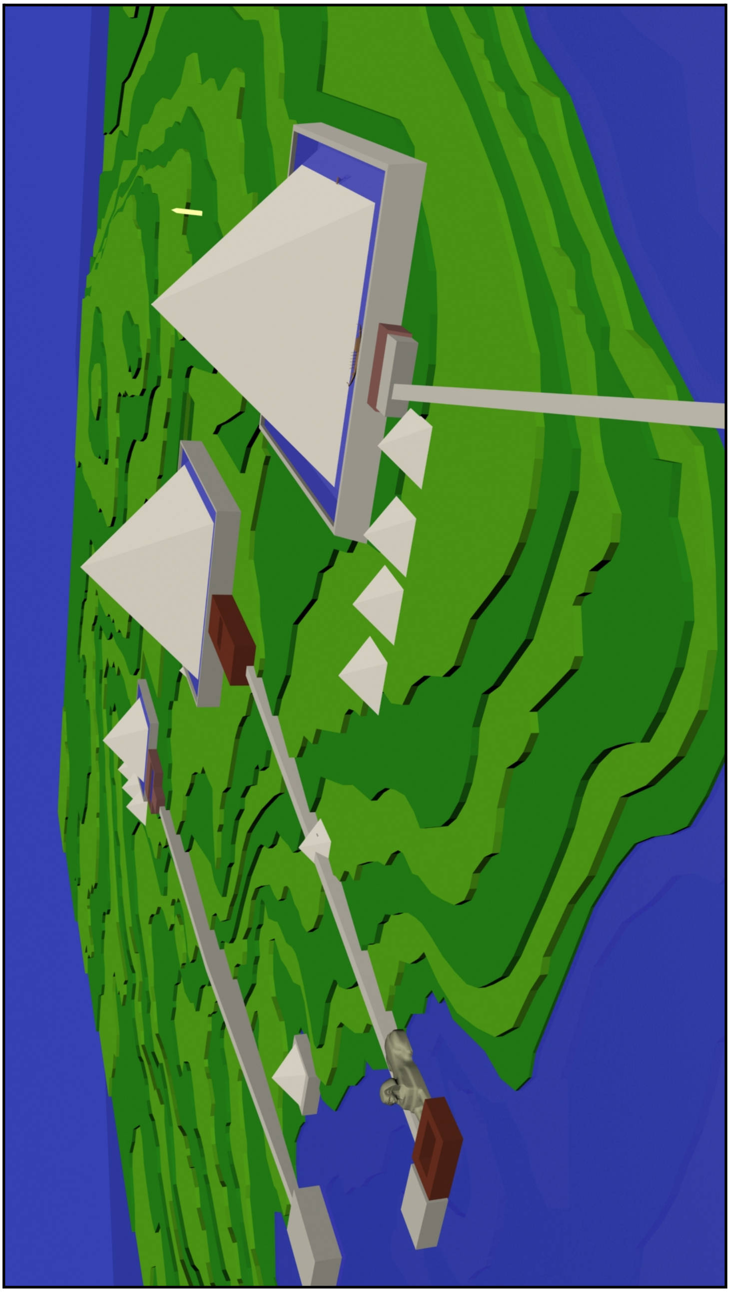


Figure 17.3: OBSERVATORY

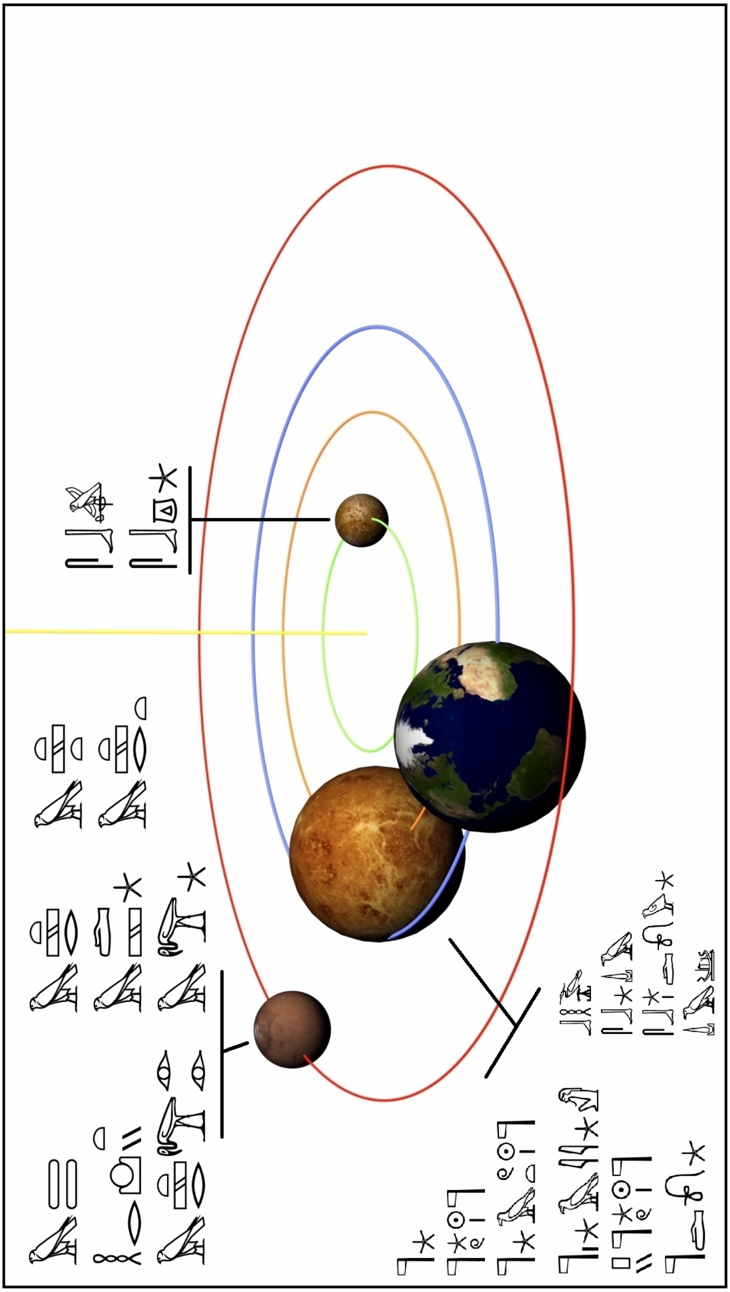


Figure 17.4: PLANET NAMES - INNER

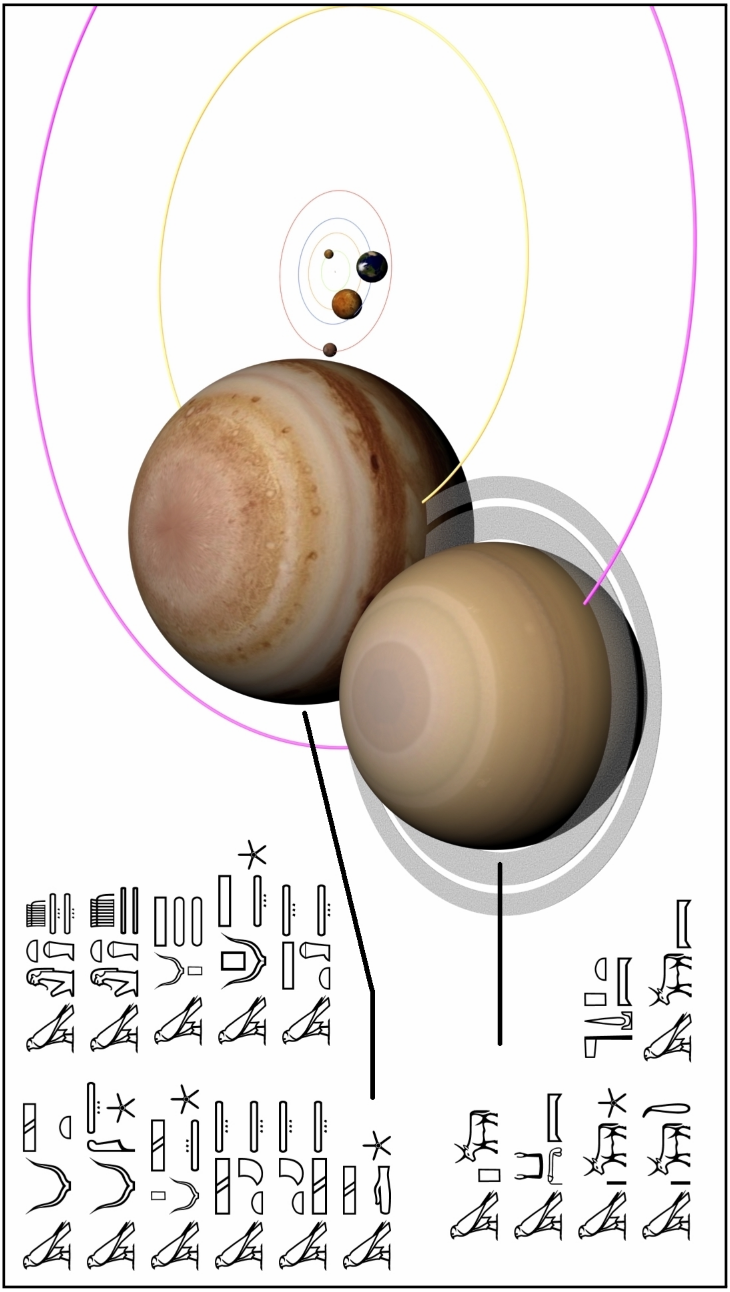


Figure 17.5: PLANET NAMES - OUTER

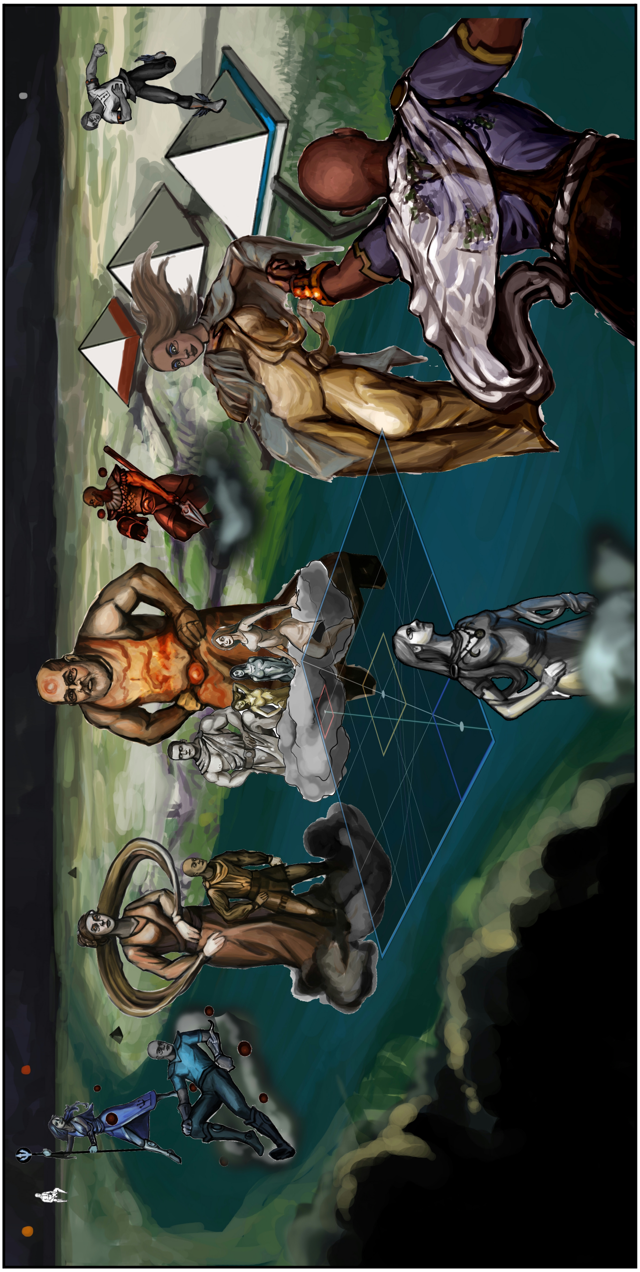


Figure 17.6: PAINTING

Chapter 18

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